Climate Investing - The Africa Opportunity

2023

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Foreword

Africa will play a pivotal role in the global drive to decarbonise. Not only is Africa rich in some of the minerals that will be required to make renewable energy viable across the globe (i.e. Cobalt, Platinum, Graphite etc.), but the continent has some of the best solar, wind and green hydrogen potential. The continent therefore offers some of the planet's biggest and most profitable options for investments in the global energy transition.

From 'green' minerals to green hydrogen - a window of opportunity for climate investing in Africa is now opening. Superior returns can be realized by smart investors who are willing to act as early movers on the continent.

An extensive expansion of investments in the supply and distribution of renewable energy is the precondition for Africa's economic promise. Driven by population growth, favourable demographics, innovation, and political stability in many countries, Africa is now one of the last frontiers of global economic growth. However, key to local value creation is access to reliable and clean energy across the continent. That's why climate investing in Africa maximises positive environmental and social impact.

Private investors will be successful if they understand and mitigate the unique risks of the region. Africa is complex and heterogeneous. For a significant number of African countries, however, perceived risks are much higher than actual risks.

With this study, KPMG makes the case for climate investing in Africa. That doesn't mean we intend to paint an unrealistic picture. Targeting both corporate as well as financial investors, we are analysing opportunities and challenges alike.

This report builds on our vast experience in advising African energy infrastructure investors and combines learnings from projects in all parts of the continent. With this study, we further hope to contribute to the expansion of climate related investment flows into Africa.

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Executive Summary

Compared to industrialised nations, African countries emit far less greenhouse gases. Calculated on an individual basis, CO_2-emissions of Africans are more than 10 times lower than those of North Americans.

Access to energy remains a key development obstacle for the continent. Africa's current 50.6% access rate to electricity is significantly less than the global rate of 87%.[9]

Africa will need USD 277 billion annually between 2020-2030 to implement its Nationally Determined Contributions (NDCs) under the Paris Agreement. Yet, the annual climate finance flows into Africa stand at only USD 29.5 billion.[7]

Some of the reasons for low energy related investment flows into Africa are currency instabilities, counterparty risks, weak institutions, low technical capacity, lack of transparency and accountability mechanisms as well as poor quality infrastructure (especially regarding electric grids).

Africa's share of global renewable energy investments and capacity installations remained relatively small over the past decade and stand at 3%. Yet the continent can draw on a vast non-hydro renewable energy resource potential such as wind and solar and low-carbon hydrogen.[12]

The continent's solar technical potential is estimated at 7,900 gigawatts (GW), more than 1000 times the current solar power electricity generation capacity. But despite that opportunity, utility-scale solar power has been systematically deployed in just a few countries.[15]

The continent's wind power generation potential is estimated at 461 GW, more than 100 times the current wind power electricity generation capacity. 27 countries in Africa have sufficient wind potential on their own to satisfy the entire continental electricity demand.[15]

Due to Africa's abundant renewable energy resources and vast non-arable land, the continent offers significant potential for green hydrogen production. It is estimated that Africa may have a production surplus of between 20 million and 40 million tonnes of green hydrogen a year by 2050, putting it in a good position to supply industrial hubs of the Global North.[38]

There are numerous risks, some unique to Africa, that need to be mitigated for renewable energy projects. But investors should be careful not to paint the entire continent with one brush: every country is different and there are numerous countries on the continent that have a stable political and regulatory environment.

Africa is often branded as the globe's problem child – when it comes to the global drive for decarbonisation, however, Africa is a key part of the solution.

The Status Quo of Climate Investing in Africa

Africa has always sparked images of diverse cultures, rich minerals, and vast landscapes. For these compelling reasons, merchant routes into Africa are centuries old: Heredotus (c. 484-425 BC) wrote of the trade across the Sahara and ancient economic ties are recorded in rock paintings dating back 12,000 years. Since then, merchants from the far East and Europe have come to sell goods and trade commodities as there was much on offer in Africa. Fast forward to the present day, and Africa continues to possess many of these riches. With untapped mineral deposits, a rising middle class, as well as an emerging tech industry, Africa seems to be on the precipice of significant growth. This is underpinned by Africa's booming population, a demographic shift that will affect both the continent and the rest of the globe.

Signals from the African Union seem to suggest that Africa is leaning into an anticipated period of economic prosperity. The recently launched, African Continental Free Trade Area (AfCFTA) is the largest free trade area in the world, with 54 participating countries and access to a combined Gross Domestic Product of USD 3.4 trillion.[1] This movement towards trade integration should demonstrate Africa's commitment to enable trade, investment and the mobility of people. With so much of Africa yet to be industrialised, there is ample opportunity for investment across the continent.

Yet, despite a long history of trade, the continent attracted a low 3.5% of Foreign Direct Investment (FDIs) in 2022.[2] Factors that can be attributable to this include war, unstable regulatory and governmental environments, lack of infrastructure and poverty. This is compounded by political instability, exacerbated by the legacies of decade-long colonial rule. These factors are explored later in this report. The key point to highlight is the dichotomy between such a mineral and resource-rich land, and the low level of global trade and investment it attracts.

In the last decade, Africa has had to face another ominous threat to its economy and overall stability – climate change. Like many regions in the Global South, Africa will likely be hard hit by the impacts of rising temperatures. The State of the Climate in Africa 2021 report states that water stress alone is estimated to affect about 250 million people in Africa.[3]

Four out of five African countries are unlikely to have sustainably managed water resources by 2030. This will have major impacts on the agriculture sector, ecosystems, biodiversity, and will ultimately lead to issues in food security. Unlike wealthier countries that can put plans in place for climate resiliency, the lack of existing infrastructure, combined with the low socio-economic status of the population, can result in widespread climate displacement, lack of ability to generate income, or severe famines. As stated by Josefa Leonel Correia Sacko, Commissioner for Rural Economy and Agriculture for the African Union Commission -

> "Africa's 1.4 billion people contribute less than 3% of the world's total greenhouse gas emissions, but the continent finds itself on the frontline of this climate emergency with nine out of the ten most vulnerable countries being in Africa."[4]
>
> **Josefa Leonel Correia Sacko**
> Commissioner for Rural Economy and Agriculture for the African Union Commission

The imperative for a just transition

Global leaders have recognised the need to abate GHG emissions to slow down climate change. Under the Paris Agreement, which aims to limit global warming to 1.5°C, all signatories have been requested to submit GHG emissions targets (Nationally Determined Contributions or NDCs) to lower carbon emissions. Since 2015, these NDCs have become the main instrument for guiding policy responses to climate change. Whilst it should be noted that South Africa contributes significantly to GHG emissions through its fossil fuel power generation, other African countries produce relatively few emissions when compared to industrialised countries. A recent study by the International Energy Agency states that the average North American emitted 11 times more CO_2 than the average African.[5]

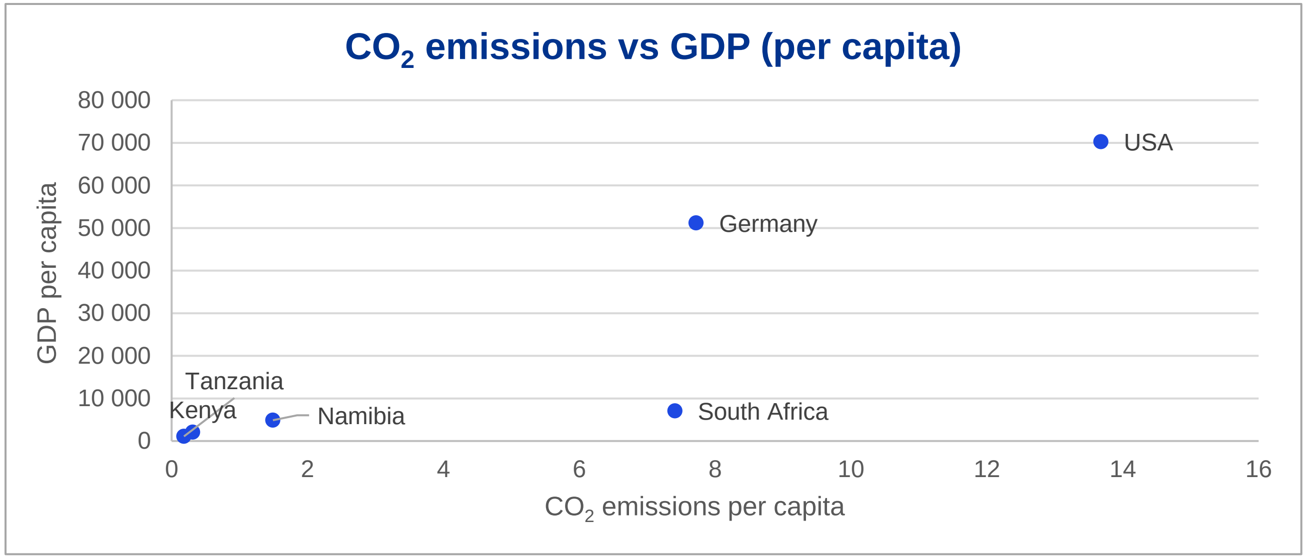


Figure 1: CO_2 emissions vs GDP (per capita)[5]

The low carbon emissions for African countries can be attributed to uneven distribution of wealth, energy use and consumption of goods and services. Yet despite their relatively low emissions, all 54 countries have signed the Paris Agreement and submitted ambitious Intended Nationally Determined Contributions (INDCs). Most of them have ratified these NDCs.[6]

It is due to this disproportionality that terms such as the 'Just Transition' have been coined, to recognise that many un-industrialised countries are having to reduce their carbon emissions, whilst at the same time trying to industrialise. This paradox made the Global North, or industrialised countries, recognise the need to support countries in the Global South to move to a clean energy mix whilst simultaneously undergoing industrialisation.

Financing the NDCs

According to the Climate Policy Initiative, Africa will need USD 277 billion annually between 2020-2030 to implement its NDCs under the Paris Agreement (CPI, 2022).[7] This is the cost of the continent's contribution to limiting warming to 1.5°C and addressing the biggest impacts of climate change. Yet the annual climate finance flows into Africa stand at only USD 29.5 billion.

African Governments have committed USD 26.4 billion of domestic public resources annually, which is about 10% of the total cost.[7] However, given rising debt levels and other development priorities from what is now being coined the 'polycrisis' (multiple simultaneous crisis), African countries may not be able to provide as much domestic public climate finance as was initially estimated. This is especially pertinent after the COVID pandemic, as even developed countries face debt distress.

To meet its NDCs, Africa will be highly dependent on inflows of both public and private finances, from both domestic and international sources as explored in more detail in the table on the right.

Table 1: Demonstrates key similarities and differences across private and public sector climate funding.

Aspect	Public Finance	Private Finance
Amount invested in Africa 2019/2020	USD 24.3 billion	USD 4.2 billion
Entities	Governments, bilateral development partners, international governments, climate funds, multinational development corporations, multilateral development banks (MDBs).	Commercial financial institutions, institutional investors, households/ individuals, corporations, development finance institutions (DFIs).
Investment trends	Supports public policy and initiatives to address climate change and increase resiliency. Often used for adaptation and mitigation projects and capacity building.	Projects and activities that align with climate goals and offer financial returns. Investments in climate change mitigation primarily driven by investment in renewables.
Accountability	Public finance is often subject to greater transparency and accountability requirements.	Private sector-driven, with accountability to shareholders and regulators.
Risk and return	Returns may not be a primary consideration.	Typical focus on financial returns. Risk varies with the investment type (e.g., green bonds are often low risk). De-risking instruments and products such as blended concessional financing exist to catalyse private sector investments.
Flexibility	May have more flexibility in directing funds towards targeted climate priorities.	Can be more adaptable and agile in responding to market opportunities.
Additionality	Often seen as a source of additional investment funds, filling gaps where private capital may be insufficient.	Seeks profitable investments. Can include making investments more sustainable or green.
Key sectors and investment fields (2019/2020)	Multilateral DFIs[7] • Cross Sectoral (31%) • Energy (24%) • Agriculture, Forestry and Other Land Use (AFOLU) (16%) • Transport (10%) • Water (9%) Multilateral Climate Funds[7] • AFOLU(36%) • Energy (36%) • Cross sectoral projects (26%)	Private Finance[7] • Energy Systems (75%) • Other Cross-sectoral (9%) • Building Infrastructure (7%) • AFOLU (7%) • Waste and Wastewater (2%) • Industry (1%)
Key historical investment countries (according to Climate Policy Initiative)	• Egypt • Ethiopia • Kenya • Morocco • Nigeria • Senegal • South Africa • Ghana	• Burkina Faso • Egypt • Ethiopia • Kenya • Morocco • Mozambique • Nigeria • South Africa

In this report, we will explore options to translate Africa's investment needs into opportunities for the private sector. This can be financially lucrative for investors, and potentially lifesaving for the millions of Africans that will be subjects of climate poverty. In the words of Nelson Mandela:

> "Like slavery and apartheid, poverty is not natural. It is man-made and it can be overcome and eradicated by the actions of human beings. And overcoming poverty is not a gesture of charity. It is an act of justice."[8]
>
> **Nelson Mandela**

Key challenges of investing in Africa

For many investors in the Global North, Africa is synonymous with chaos, political instability, and corruption. It is apparent that the continent has an image problem, which in turn drives reluctance for foreign investment. Yet is this reluctance founded?

A fragmented continent

One of the key reasons for reticent investor sentiment is the continent's diverse and complex economic landscape. Africa comprises 54 countries, each with its own political, governance, and business environment. This makes it difficult for investors to navigate the differing rules and regulations, as well as discern which countries are more conducive for new and existing investment.

Many African countries suffer currency instability, counterparty risks, lack of technical capacity, transparency, and accountability mechanisms. This is underpinned by unstable governments making it challenging for investors to feel secure in undergoing long-term commitments.

It should be noted however, that while political uncertainty is extremely high for places like Somalia or Chad, other countries such as Ivory Coast, Botswana or Mauritius are more stable. For example, Botswana is one of Africa's fastest growing economies, as measured by GDP, over the last five decades. It has been viewed as a 'success story' of market-centred governance approaches, including the protection of property rights, strong rule of law, and transparency in government. By painting Africa with a broad brush, perceptions about the real market opportunities and risks become distorted.

Infrastructure

Unreliable infrastructure posts significant hurdles to business operations and can drive up costs. Africa's current 50.6% access rate to electricity is significantly less than the global access rate of 87%.[9] Even South Africa, which once had enough electricity to sell to neighbouring countries, is now experiencing power shortages and loadshedding. This is estimated to be costing the South African economy USD 51 million per day.[10]

Poor access to energy in Sub-Saharan Africa (SSA) has curtailed the region's growth potential. Per capita consumption of energy in SSA (ex. South Africa) is 180 kWh, compared to 12,000 kWh per capita in the United States and 5,500 kWh in Europe.[11]

Public investment in base load generation has traditionally been focused on legacy fossil energy and hydropower. According to the International Energy Agency (IEA), most national grid systems are bedevilled with high technical and commercial network losses. The inefficiency is largely due to lack of Supervisory Control and Data Acquisition (SCADA) systems, government budgetary constraints, and the inability or delays to attract capital and private sector management.

Foreign Exchange (FX)

Foreign exchange (FX) or currency risks significantly impact the profitability and viability of renewable energy projects in Africa due to the fluctuation of local currencies against the currency of the investor. This risk arises primarily from the mismatch between the currency in which revenues are generated (local currency) and the foreign currency used to finance the investment. For example, if revenues in a local currency depreciate against the investment's foreign currency, it directly affects project profitability and ultimately project returns.

A practical mitigation strategy is securing project financing from local banks in the same local currency as revenues where such facilities are available. This approach aligns the currency of project revenues with debt financing costs, substantially reducing the FX risk. Local currency financing stabilises the financial structure by matching the currency of electricity sales with loan repayments, partially protecting the project's financial performance from currency fluctuations. Additionally, this strategy supports the local financial sector and fosters an ecosystem conducive to renewable energy investments. However, it is generally much more challenging to mitigate the FX risk on the equity component of the investment.

Africa's Decarbonisation Potential

Although Africa's share of global renewable energy investments and capacity installations remained relatively small over the past decade at 3%, the continent can draw on a vast non-hydro renewable energy resource potential such as wind and solar and low-carbon hydrogen.[12]

Africa receives annual average solar irradiation of 2,119 kilowatt hours per square meter (kWh/m^2)[13] and annual average wind speeds of 6 meters per second (m/s) with averages reaching 7 m/s in North and Southern Africa.[14] This demonstrates the important role wind and solar can play in bringing clean, affordable electricity to millions in the continent that lacks access to electricity.

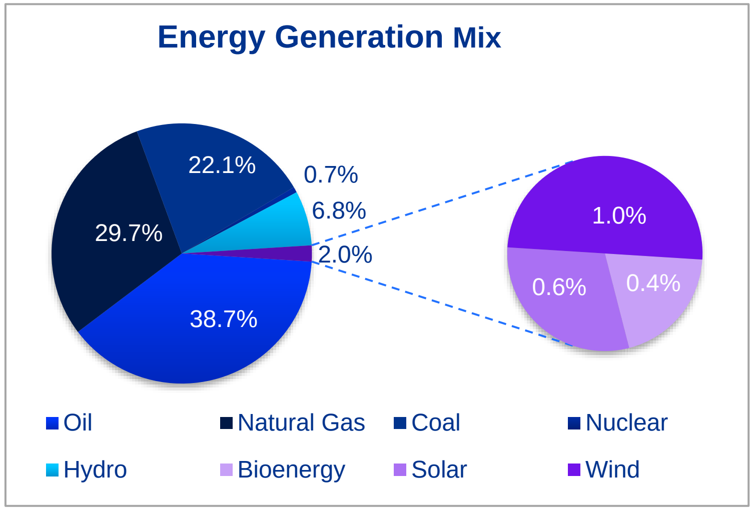


Figure 2: Africa's Energy Generation Mix[12]

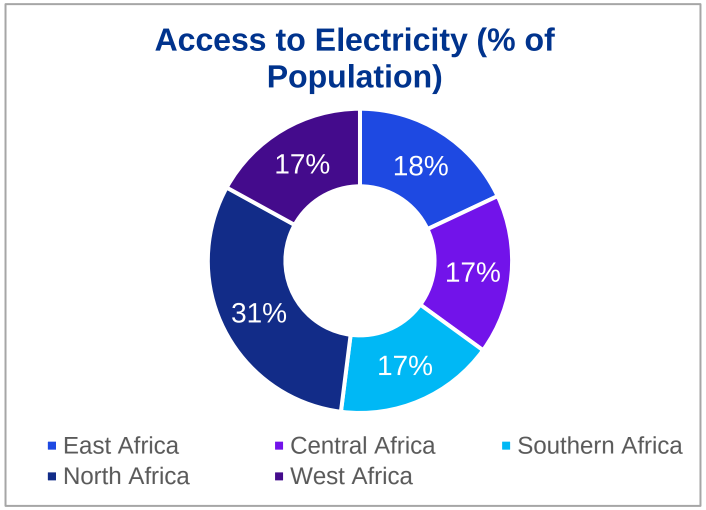


Figure 3: Access to Electricity (% of Population)[9]

Table 2: Regional comparison of solar irradiance and wind speed.

Region	Solar Irradiance (kWh/m^2)	Wind Speed (m/s)
East Africa	2100	5.5
Central Africa	2000	4
Southern Africa	2160	6.2
North Africa	2200	7
West Africa	2100	6
Africa Region	2119	5.7
North America Region	1882	4.3
Europe & Eurasia Region	1124	5.5

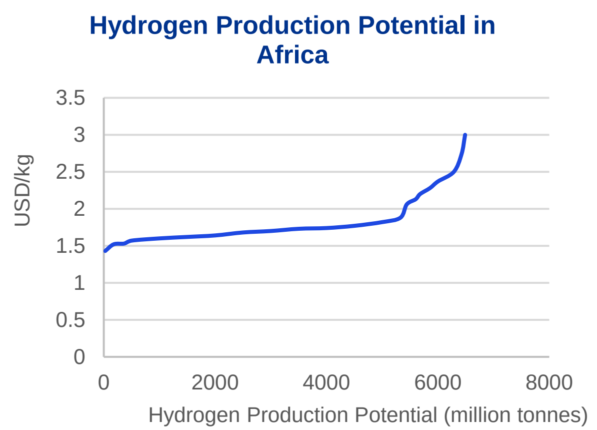


Figure 5: Hydrogen Production Potential in Africa[11]

Solar Energy

The continent's solar potential is estimated at 7,900 GW, more than a 1000 times the current solar power electricity generation capacity,[15] indicating massive opportunities for solar power generation. But despite that potential, utility-scale solar power has been systematically deployed in just a few countries.

Wind Energy

The continent's wind power generation potential is estimated at 461 GW[15], more than 100 times the current wind power electricity generation capacity. Bringing the installed capacity closer to the potential capacity can boost Africa's transition to affordable and reliable clean energy.

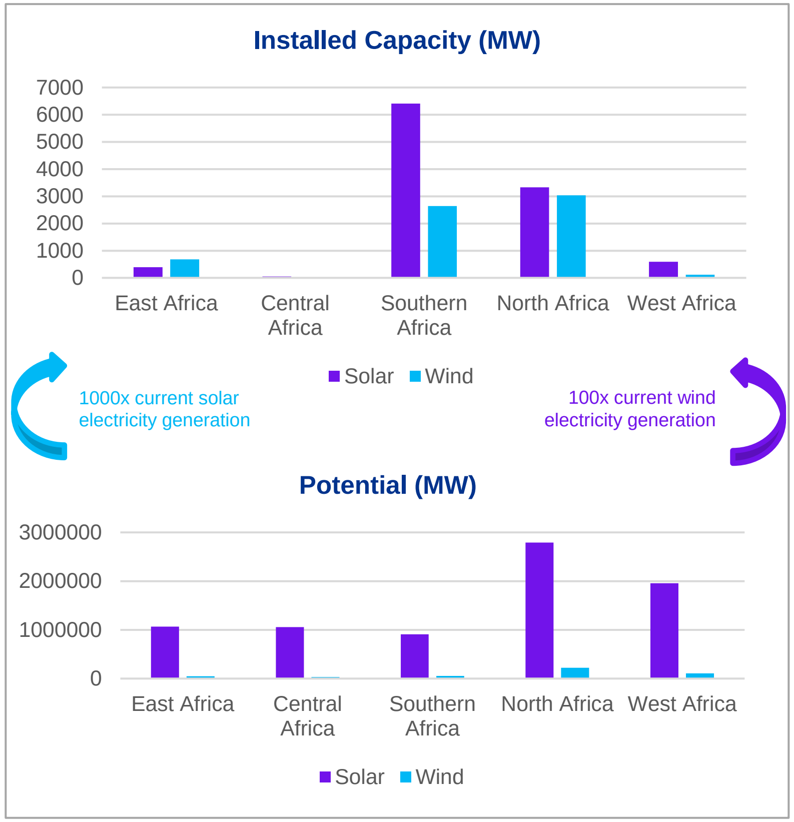


Figure 4: Installed Capacity and Potential (MW)[15]

Green hydrogen and ammonia

The current use of low-carbon hydrogen and ammonia in Africa is minimal, but Africa has one of the largest potentials worldwide for producing hydrogen and ammonia from renewables at relatively low cost.[11]

There are several challenges to develop hydrogen infrastructure at scale, particularly around the high cost of clean manufacturing and industrial development of hydrogen, the significant demand for water, which is scarce across Africa, and the policy framework that needs to be backed up by the economic feasibility of hydrogen exports. That is where long-term investments, utilising existing resources, could drive hydrogen production while also generating export revenues for decades to come.

Private sector investments on renewables in Africa

Despite its renewable energy potential and the record-levels of global renewable energy investment - around USD 434 billion in 2021, only 0.6% of that investment was made in Africa, which accounts for the lowest in the past eleven years and stands in stark contrast with Africa hosting 20% of world's population.[16]

Financing Clean Energy in Africa, a recent report by the IEA in partnership with the African Development Bank Group (AfDB), found that providing universal electricity access to all Africans requires USD 22 billion annually from now to 2030. Investments in access to electricity in sub-Saharan Africa stand at only around 15% of this total today.[17] Closing the access to electricity gap, and accelerating decarbonisation of industries and economies broadly, will require mobilising financing at scale. This includes greater investments by the private sector, in addition to financing by the public sector, multilateral development banks, and other international financial institutions.

Current gaps in renewable energy investing and decarbonisation efforts, therefore offer tremendous opportunities for private sector investors, including private equity and venture capital firms to invest in solar energy, wind, and green hydrogen/ammonium.

The Africa Investment Forum held during the AfDB's 2023 Annual Meetings showcased four renewable energy and sustainability projects worth about USD 1.5 billion to investors. The AfDB also highlighted its current pipeline of renewable energy and sustainability projects. This included 90 deals, valued at USD 62.9 billion. All of these projects are either in the capital raise phase or in the bankability phase.[18]

Between 2017 and 2020, USD 21.1 billion of renewable energy financing were realised across 1,480 projects in Africa. Nigeria topped the list with the highest amount of financing received.

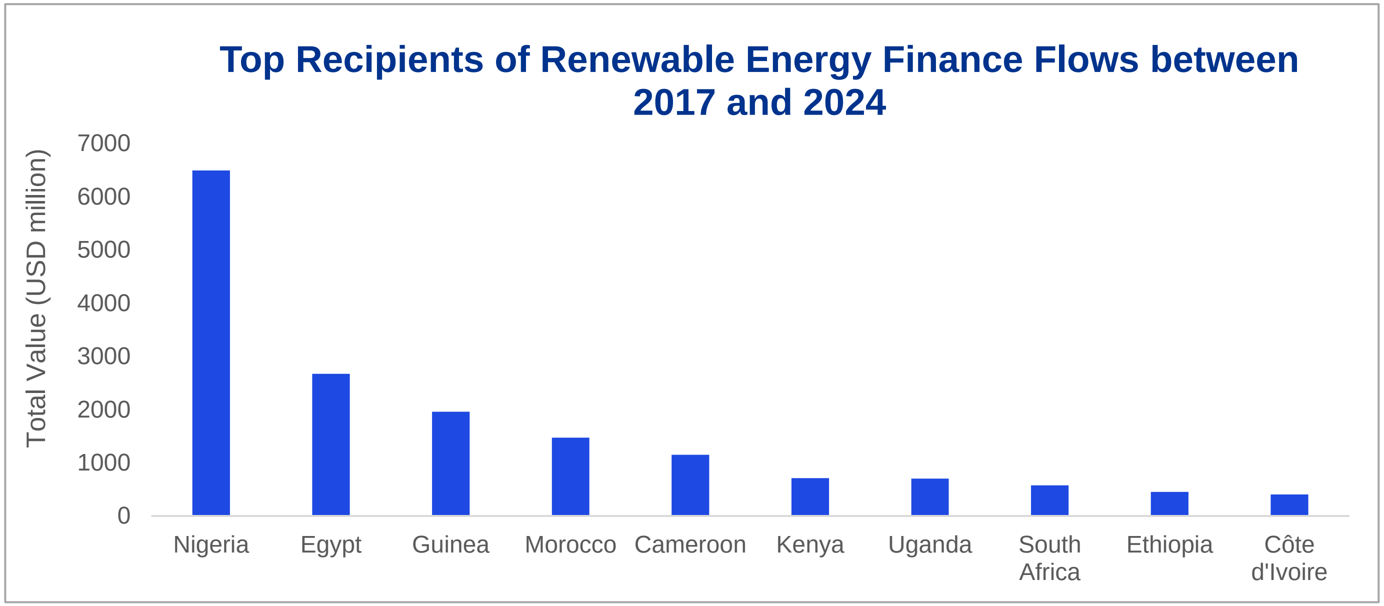


Figure 6: Top Recipients of Renewable Energy Finance Flows between 2017 and 2024[19]

Top providers of renewable energy finance include Exim Bank of China, IFC, World Bank's IDA, EIB, KfW and the French Development Agency.

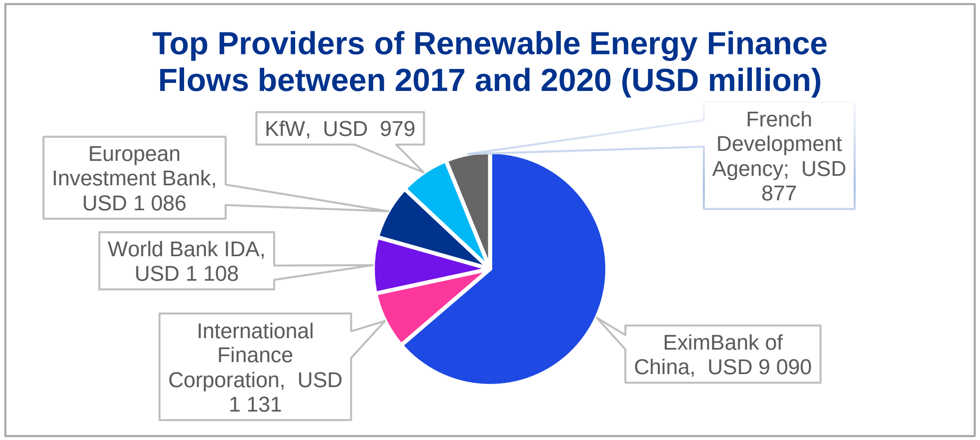


Figure 7: Top Agencies of Renewable Energy Finance Flows between 2017 and 2020 (USD million)[19]

Hydropower dominated Renewable Energy Finance Flows to Africa, followed by solar energy.

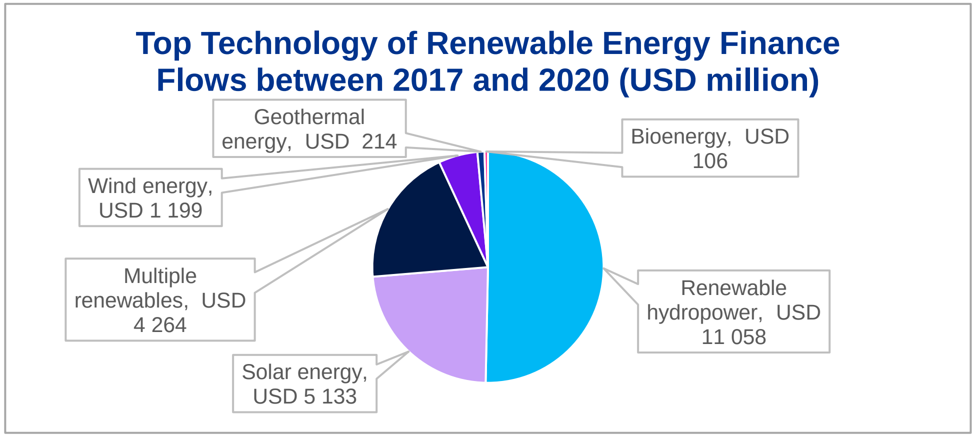


Figure 8: Top Technology of Renewable Energy Finance Flows between 2017 and 2020 (USD million)[19]

Since 2010, the top 5 countries booked over USD 1.3 billion in terms of the total value of M&A transactions, private equity investments, and impact fund investments across solar and wind. South Africa, 5th in total value, ranked 1st in quantity of deals.

Table 3: Private Capital deals across African countries between 2010-2023[20]

Recipient	Sum of Deal Size (USD million)	Project Count
Kenya	536.0	13
Chad	375.3	2
Egypt	322.2	7
Senegal	84.9	2
South Africa	72.9	31
Mauritius	37.2	3
Botswana	26,5	3
Namibia	10.0	3
Morocco	7,6	3
Tunisia	-	1
Tanzania	-	3
Madagascar	-	1
Ghana	-	1
Grand Total	**1,472.5**	**73**

Enabling policies to unlock private investments in renewable energy

Policies addressing regulatory and other challenges play a key role in helping to unlock private capital flows to countries in Africa. In this regard, there have been notable efforts in rolling out new policies on renewable energy investments, climate adaptation, mitigation and resilience. The table on the right highlights some examples of the major and recent policies (post-2020) as well as announced policies/ proposals supporting the development of renewable energy sectors in Africa.

Table 4: Selected major policies and announced policies/ proposals supporting the development of renewable energy sectors in Africa

Policy	Coverage	Country	Description
Long-term Carbon Strategy 2050	Green hydrogen and renewables	Morocco	Long-term Carbon Strategy 2050 is an initiative by the government to become carbon-neutral by 2050.
National Roadmap for Green Hydrogen	Green hydrogen, solar, wind, and ammonia	Morocco	Three-phased hydrogen (2020-2030, 2030-2040 and 2040-2050) development strategy to augment the hydrogen utilisation within the country by co-integrating its production with solar and wind.
Industrial Recovery Plan 2021-2023	Renewable energy	Morocco	The Ministry of Industry, Trade, Green and Digital Economy announced the plan for Industrial recovery with three primary objectives, of which one focuses on decarbonisation of industries by utilising renewable energy sources.
OCP Group Green Investment Program	Solar and wind	Morocco	The OCP group (A state-owned phosphate rock miner) launched its Green investment Program 2023-2027 which aims to enhance the production of green fertilisers and clean energy. It has an additional target of achieving 5 GW of clean energy by 2027 and 13 GW by 2032.
Tatwir Green Growth Program	Renewable energy	Morocco	Support program for MSMEs and startups to develop the new green industry sector by providing support through funding channels.
Nigerian Economic Sustainability Plan	Solar and clean energy	Nigeria	Economic recovery strategy outlining ten policies, of which two drive clean energy development.
Energy Compacts (Voluntary commitments to SDG7 and energy transitions from UN Member States)	Solar and green hydrogen	Nigeria	Voluntary commitments by the Nigerian government to achieve SDG 7 (affordable and clean energy) by developing technologies, mobilising investments, and raising investments and infrastructural support.
Namibia Green Hydrogen and Derivatives Strategy	Green hydrogen	Namibia	Action plan which articulates the strategies to make Namibia the global leader in hydrogen production by 2050.
Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)	Solar and wind	South Africa	National program which aims to procure 2.6 GW of solar and wind power through providing a conducive environment for public sector investment.
South African Renewable Energy Masterplan (SAREM)	Renewable energy (solar and wind)	South Africa	Strategic plan to harness growing demand for renewable energy and storage technologies to stimulate industrial growth and inclusive development in South Africa.
Hydrogen Society Roadmap South Africa (HSRMSA)	Green hydrogen	South Africa	The plan aims for net-zero carbon growth by 2050 through decarbonising transport and industries, enhancing green power, establishing a hydrogen product manufacturing center, creating a green hydrogen export market, and increasing hydrogen's role in the energy system.
Feed-in Tariffs (FiT) Policy	Renewable energy (Biomass, Biogas and Small Hydro technologies)	Kenya	Updates to Kenya's Feed-in Tariffs policy to limit eligibility for FiTs to small scale projects under 20 MW, applicable only to Biomass, Biogas and Small Hydro technologies.
Renewable Energy Auctions Policy	Solar and wind	Kenya	Introduction of competitive auctions for solar and wind installations exceeding 20 MW of capacity.
Least Cost Power Development Plan	Renewable energy	Kenya	10-year rolling policy plan which aims to integrate the recovery of the power sector with the commitments of the country to climate actions.
Renewable Energy and Energy Efficiency Strategy and Action Plan (RRESAP)	Renewable energy	SADC (Southern African Development Community)	Action plan constituted by the Southern African Development Community (SADC) to achieve energy efficiency and increase the usage of renewable energy in the Southern African region by 2030. It also promotes public-private-partnerships (PPPs) and leverages multiple financing mechanisms such as grants, subsidies etc.

Promising demographic trends to meet workforce demand

As per the 2023 report by the International Renewable Energy Agency (IRENA) and the International Labour Organization (ILO)[21], global employment in renewable energy reached 13.7 million in 2022, which is an increase of one million since 2021 and up from a total of 7.3 million in 2012.

Out of these 13.7 million jobs in the renewable energy sector in 2022, it is estimated that Africa accounts for only 320,000 jobs. The scaling of renewable energy investments across the globe will depend on the availability of skilled workers across countries – and this is where the African demographic trends could play a key role in supporting the scaling of renewable energy on the continent.

In 2021, South Africa, Nigeria, Morocco, Uganda and Kenya had the largest workforces within the identified energy sectors, totaling to over 155,000 workers. Despite the significant growth rate of renewable jobs in the past two years on the continent, these numbers are low when compared with Asia and South America. However, Africa is the fastest growing (population) and youngest region in the world, offering a significant window of opportunity for the countries in the region to provide young skilled workers that will meet the workforce demand of firms investing in energy transition for decades to come.

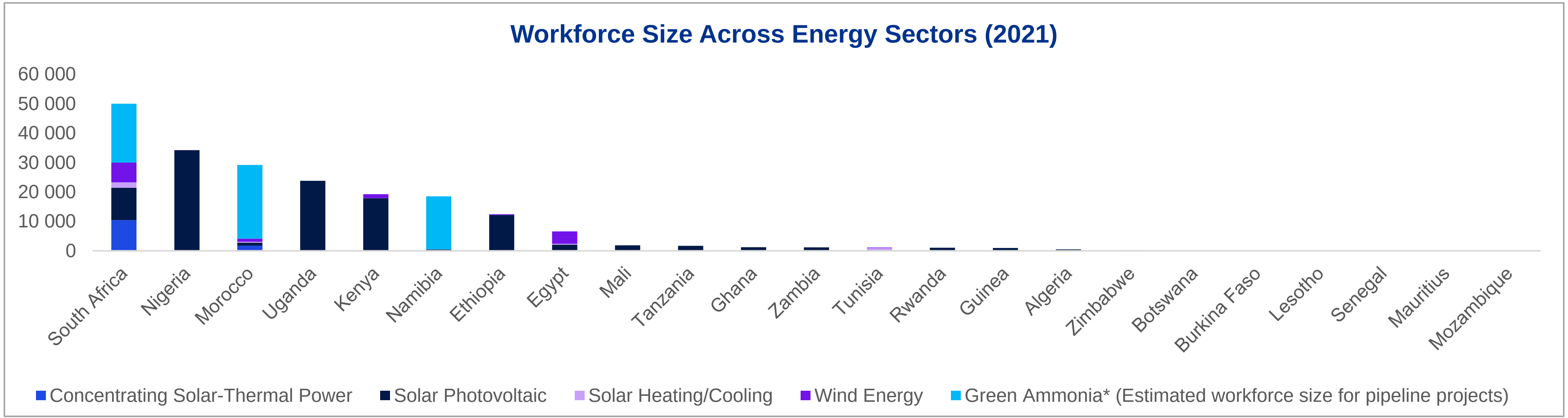


Figure 9: Country workforce size across energy sectors (2021)[21]

The Solar Landscape

The Case for Solar in Africa

Global investments in solar energy surpassed the USD 200 billion mark in 2021. However, Africa, the Middle East and the Caribbean contributed to a meagre 8% of overall solar investments.[22] The UK, India, Spain, Turkey and Brazil have an installed generation capacity of 77 GW[23], 416 GW[24], 118 GW[25], 100 GW[26], and 189 GW[27] respectively. Meanwhile in Sub-Saharan Africa, countries like Mozambique, Kenya and Nigeria have an installed electricity generation capacity of only 2.8 GW[28], 3 GW[29] and 16 GW[30] respectively.

The investment case for harnessing solar energy is cemented by the continent's solar irradiation quality, yield and abundance as shown in Figure 10.

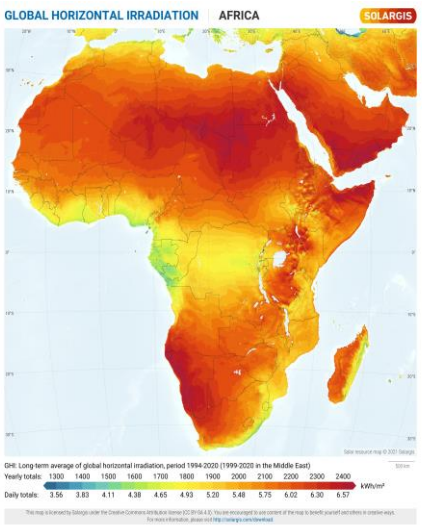


Figure 10 : Bankable Global Horizontal Irradiation range across Africa between 3.31 – 6.97 (kWh/m²/day)[10]

Irradiance is a measure of the rate of energy received per unit area. Global horizontal irradiance (GHI) is the total irradiance from the sun on a horizontal square meter surface on earth. The photovoltaic (PV) potential is defined in the unit kWh and indicates the kWh of electricity that would be generated by a PV system over a surface area. The higher the GHI value in an area, the more power a PV system will produce. In Spain for example GHI is estimated as being at between 1.48 and 3.56 kWh/m²/day. As can be seen from the GHI Map in figure 10, most parts of Sub-Saharan Africa have at least double these GHI values.

The use and application of Solar PV across the continent has increased in recent years, largely driven by private investors. The value of imported solar PV panels rising from USD 1.2 billion in 2020 to USD 2.1 billion in 2022, catalysing an electricity market for Solar PV estimated at 1.7 GW in 2021.[31]

The African solar landscape has gradually emerged into distinctive off-grid and on-grid markets. off-grid solar PV systems, also referred to as Decentralised Renewable Energy (DRE), are power systems that generate electricity, store that power in batteries, and run independently from the power grid. These systems are therefore not using, or depending on public utilities. These are smaller systems, typically less than 1 MW, either deployed as solar home systems, mini-grids for communities, or rooftop systems which can be utilised by commercial or industrial (C&I) companies.

on-grid systems are grid-connected systems that co-exist with a national grid and utility. Utility-scale solar PV installation refers to power plants whose operation is fed into the dispatch and electricity distribution of a utility.

The off-grid solar market has received significant attention in the last couple of years. This can be attributed to the relatively poor performance of public utilities, falling cost of solar components, a large and growing cohort of mini-grid developers and increasing economies of scale. The sector has attracted various climate-aligned and impact-driven investors, as off-grid solar aligns with their sustainable development goals and the push to displace fossil fuels and reduce deforestation.

Given the interest and popularity of mini-grids and solar home systems, it is noteworthy that the quantum of investment flows have, however, still been heavily tilted towards utility scale solar projects.

As renewable energy gains traction in Africa, deal sizes and exits have seen remarkable expansion over the last decade, moving from single digit median ticket sizes in the early part of the decade, to over USD 132 million in deal sizes recently.[32]

Regional split

A mixture of the sheer size of the need for energy access, and a raft of government and donor led initiatives, have seen West Africa developing more solar projects than any other region on the continent in recent times.

Private equity funds have historically been more active in countries outside Central, East and West Africa: most investments on the continent have traditionally been in Southern and Northern Africa. An estimated USD 1.2 billion in private capital has been invested from within and outside these regions, with the largest deal size seen for Solar PV projects coming to c. USD 330 million. However, our research shows that the number of solar projects are now concentrated in West and East Africa, as reflected in Figure 11. The number of projects arising from these investments in West and East Africa seem to be well aligned with the energy access gap opportunities in these regions.

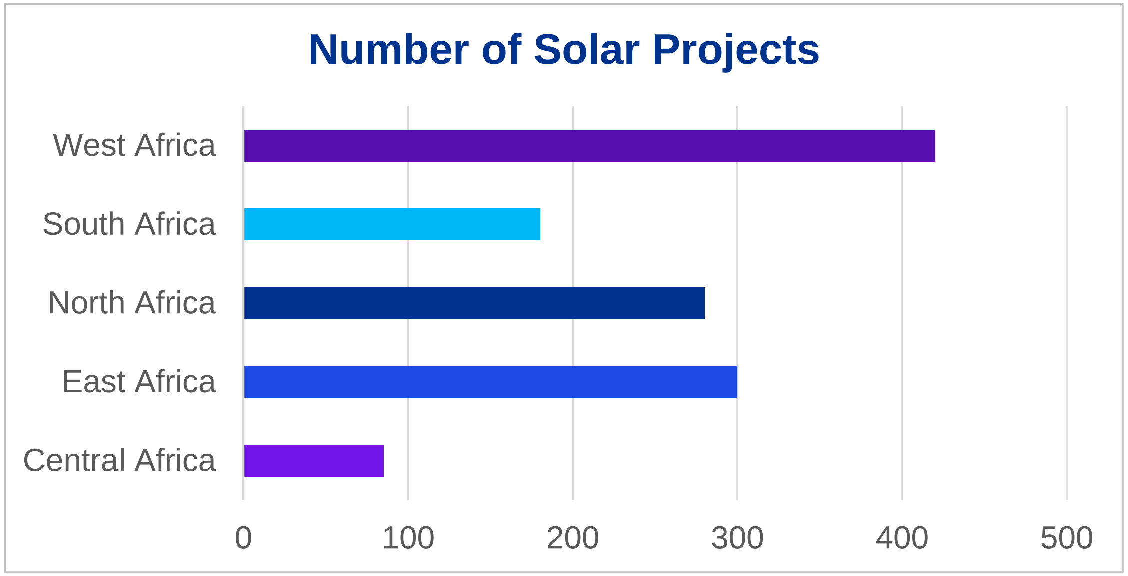


Figure 11: Regional Spread of Solar Projects (2000 - 2020)[32]

Solar private capital examples

Given the energy access gap, there has been a number of private equity backed deals, and successful capital raised from impact funds across Sub-Saharan Africa. Two Private Equity backed deal examples include the PEG Africa, who had raised over USD 50 million prior to its acquisition by Bboxx, and Daystar Power, who had done a USD 97 million capital raise prior to its acquisition by Shell. PEG Africa, headquartered in Senegal, is the operator of an asset-financing platform designed to offer loans to individuals and Small and Medium Enterprises (SMEs) for solar home systems to off-grid households in West Africa. They are using a pay-as-you-go financing approach, which are enabling customers to replace their perpetual spending on poor-quality polluting fuels, such as kerosene and petrol, with solar energy. Daystar Power on the other hand focuses on hybrid solar power solutions for commercial customers for either a cash sale or a monthly fee. Daystar Power, Headquartered in Nigeria, delivers PaaS (Power as a Service) or SaaS (Solar as a Service) principally to Commercial and Industrial (C&I) customers through long term contracts with zero upfront costs.

The Wind Landscape

The Case for Wind Energy in Africa

According to the Africa EU Energy Partnership, ("AEEP") secretariat, if all of the global new wind power installations in 2020 had taken place in Africa (and if the grid would have been ready to receive and distribute it), this new annual capacity alone would have sufficed to close the energy access gap in Africa within twelve months for the more than 600 million people needing it.[33]

The Global Wind Council estimates that Africa is only using 0.01% of its wind potential,[34] yet this wind potential in Africa is so significant that it could satisfy electricity demand 250 times over.

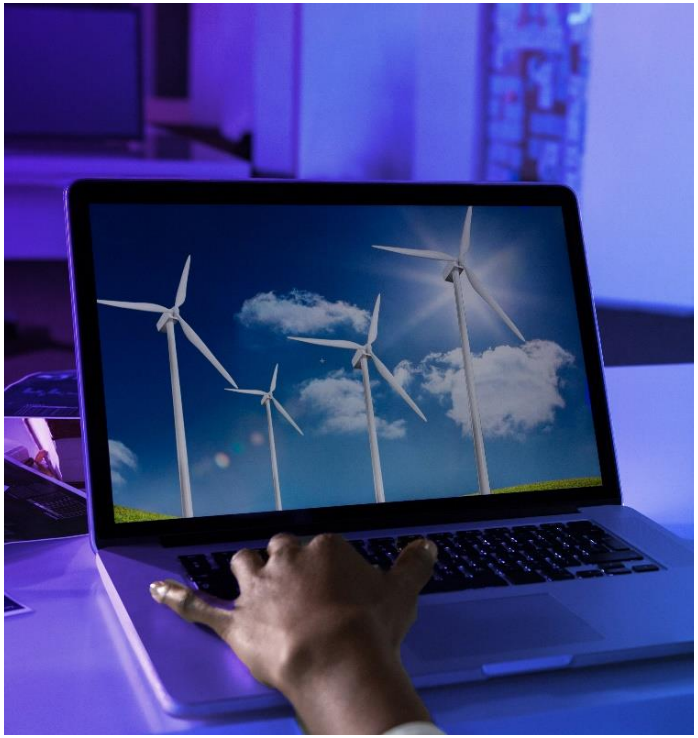
Additional research, carried out by Everoze, found out that 27 countries in Africa have sufficient wind potential on their own to satisfy the entire continental electricity demand which is estimated at 700 TWh annually.[35]

This untapped potential can be linked to the requirements and various challenges associated with wind projects.

Inadequate infrastructure and grids

Wind energy projects are often situated remotely, far from existing grid infrastructure. This challenge is compounded by the fact that many African nations grapple with poorly maintained transmission and distribution networks. This creates a situation of installed but unusable electricity, as transmission lines are often expensive to build.

In addition, the integration of variable wind resources can be more complex in the context of weak grids.



Cost of wind installations

Wind projects require longer project development lead times, as they need longer on-site measurements to make a wind resource assessment which is key to bankability, at least one year of biodiversity surveys to capture migration patterns and have more complex (compared to solar) geotechnical and civil works. This is exacerbated further by unclear regulations which can lead to lengthy permitting processes. The longer development time, leads to the high costs associated with wind installations, which then require scale and government involvement or offtake from local utilities. The creditworthiness of these utilities (perceived and real risk) generally leads to a higher cost of capital.

Environmental and social risks

Land acquisition and compensation is always a challenge for large projects in Africa, and wind projects are no exception. Wind power projects have the additional complexity of environmental and biodiversity risks to wildlife, especially birds and bats.

Social conflicts and Insecurity

Project developers in Africa face challenges in addressing opposition to new wind (and in some instance solar) farms as they are perceived to disrupt the way of life of local communities.[36] Additionally, places that are considered suitable for wind power installations such as Sudan, Niger, Chad and the northern parts of Nigeria periodically suffer from armed conflicts, posing major security challenges.

Africa's wind energy potential

Africa's extensive coastlines are home to substantial wind power production potential for small-scale and utility-scale turbines. With advancements in wind power technology, the possibilities of capturing wind productively in sites considered to have low wind speeds have also significantly increased. Research conducted by the IFC in 2020 indicated that Africa's potential wind power generation is almost 180,000 TWh, more than sufficient to meet the continent's electricity demand.[35]

According to analysis conducted by the IFC in 2020, Algeria was reported to have the highest resource followed by Sudan and Libya. The three countries had a combined total of about 20,000 GW of potential installed capacity. Twelve other countries have technical wind potentials over 1,000 GW, including Mauritania, Mali, Egypt, Namibia, South Africa, Ethiopia and Kenya. Through the use of high-resolution mesoscale wind models, and the use of tall, large rotor, modern turbines, wind power also becomes viable for countries with lower wind speeds, including Ivory Coast, Nigeria, Botswana, Cameroon and Mozambique.

The analysis conducted by the IFC demonstrates that Africa has the potential to produce clean, affordable and reliable wind energy.

Since the IFC analysis in 2020, other countries such as Egypt, Morocco and Djibouti have installed new wind power plants to harness this resource. Recent significant projects are listed below:

- Morocco commissioned its 14th project, Boujdour wind farm, which is expected to produce 300 MW of clean energy, reducing greenhouse gas emissions by approximately 1.15 million tonnes of CO_2 per year.
- Djibouti inaugurated its first wind farm, Red Sea Power wind farm, which is estimated to produce 60 MW of clean energy, boosting the country's overall capacity by 50% and averting more than 250,000 tonnes of CO_2 emissions annually.
- In Egypt, Acwa Power signed an agreement with the New and Renewable Energy Authority to build a 10,000 MW wind farm. The wind farm is set to be the largest wind farm in Africa and the Middle East. It is estimated to produce over 40,000 GWh of clean energy and reduce 9% of the country's annual carbon emissions.

These projects demonstrate the opportunity for wind power investment in Africa.

Case study – Lake Turkana Wind Power Project ("LTWP")

Overview of the project

The LTWP is in Loiyangalani District of Marsabit West County in Kenya. The project lies between Mt. Kulal and Mt. Nyiro, which effectively act as a funnel, causing the wind to flow through the area at high speed. The project occupies an area of 40,000 acres. 99.8% of this land is open to the public and continues to be used by surrounding communities for living, livestock grazing and access to water points. The project was conceptualised in 2005 and was completed 12 years later in 2017 with 365 turbines installed for full commercial operation at a capacity of 310 MW. The project is the largest wind farm in Africa, developed at a cost of USD 685 million. The generated power is transmitted to the national grid via a 400 kV overhead transmission line to a substation at Suswa, approximately 428 km from the project. The transmission line was built by Kenya Electricity Transmission Company (KETRACO), a state entity.

Project timeline

In January 2010, LTWP signed a power purchase agreement (PPA) with the Kenya Power and Lighting Company (KPLC). The project, however, faced various challenges in securing financing.

In 2012, the World Bank Group (WBG) withdrew a partial risk guarantee of up to USD 78 million that they had offered to support default risk and transmission risk for the project. The WBG's main concern was that Kenya would not be able to consume all the electricity. The withdrawal of the guarantee was a move that threatened the commitment of other investors.

In 2014, LTWP closed a financing agreement with the African Development Bank (AfDB) who then became the lead arranger, with Standard Bank and Nedbank acting as co-arrangers. AfDB and the European Investment Bank (EIB) covered the default and transmission risks. Other lenders were FMO, Proparco, East African Development Bank, PTA Bank, EKF, Triodos, US Overseas Private Investment Corporation (OPIC), and DEG. The project also attracted equity investments of about USD 145 million, provided by Aldwych International, KP&P BV Africa, the Norwegian Investment Fund for Developing Countries (Norfund), the Finnish Fund for Industrial Cooperation Ltd (FinnFund), Vestas Wind Systems A/S, Danish Investment Fund for Developing Countries (IFU) Denmark, and Sandpiper Limited. It took more than five years to reach financial close post the PPA sign-off.

The journey to successful financial close was aided by political goodwill and government support, as well as partial risk guarantees provided by credible DFIs, thereby attracting more capital into the project.

By March 2022, LWTP reported three full years of uninterrupted operations. The project provided 16% of Kenya's produced energy at a 62% capacity factor, whilst mitigating 680,000 tonnes CO_2 emissions in 2022.

In 2023, Milele Energy completed the purchase of a 25.25% equity stake in LTWP. BlackRock Alternatives through its public-private finance vehicle, Climate Finance Partnership (CFP), announced the potential acquisition of the stake held by the Finnish Fund for Industrial Cooperation Ltd (FinnFund), Vestas Wind Systems A/S and Danish Investment Fund for Developing Countries (IFU) in the project. This acquisition, if successful, would represent a 31.25% ownership in the project. These secondary market investments are a testament that a well-structured PPP wind power project has the potential to attract global international capital once the project is sufficiently de-risked.

Challenges that had to be overcome

The LTWP encountered various challenges during its development. Some of which are highlighted below:

a) Securing financing: LTWP suffered a series of setbacks in securing financing which delayed construction commencing in 2011 to 2014. WBG pulling out of the project in 2012 further delayed the financial close, as the project had to secure risk guarantees from other credible DFIs.

b) The project implementation delays by KETRACO: The project implementation faced delays in the construction of the transmission line that caused a 1-year delay in connecting the generated power to the grid. As a result, KETRACO had to pay USD 52.5 million to LWTP for the delay.

c) Dissatisfaction from some stakeholders over its interactions with affected communities. The pastoral lifestyle of the host community and lack of formal land titling made it difficult to determine the legal ownership of the land. Therefore, the project sponsor faced hostility from the local community that cited land grabbing claims.

Positive Impact

The development of LWTP has had meaningful impact in the following ways:

a) Reliable, clean and low-cost energy contributing 16% of Kenya's produced energy. This further results in significant foreign exchange savings because of the reduction of oil imports.

b) Its grid contribution has significantly reduced dependency on hydropower, mitigating against blackouts during drought seasons.

c) Greenhouse gas mitigation: The project mitigated 680,000 tonnes CO_2 emissions in 2022.

d) Infrastructure development: the project has upgraded more than 200km of roads from Laisamis to the wind farm sites.

e) Socioeconomic growth: the project employs about 330 people, of whom 85% come from Marsabit County. The project has provided support to health facilities and participated in an emergency food program. The project has supported schools by providing solar systems, water tanks, piping systems, and construction of laboratories, classrooms, dining halls and administration blocks.

Deep Dive on Green Hydrogen in Africa

Global green hydrogen momentum

Green hydrogen has been identified as a key enabler of energy and climate change strategies across the globe. The attention that green hydrogen has received, is largely due to its ability to decarbonise various sectors of the economy where emissions are difficult to reduce. These energy-intensive industries include, but are not limited to, the production of iron, steel and chemicals, long-distance transport (shipping and aviation), oil refineries, fertiliser production, and building materials (glass and cement).[37] The broad applicability of green hydrogen in multiple sectors makes the technology a versatile energy carrier in comparison to other energy sources, such as wind and solar, that are primarily used for electricity generation. As most renewable energy sources can be intermittent due to their dependency on weather conditions, green hydrogen can act as a complementary resource, as it provides a way to store excess energy during periods of high production for when renewable energy generation is low. Driven by green hydrogen's potential to support the worldwide shift towards cleaner energy, there has been a notable increase in the number of green hydrogen project unveilings since 2019.[38] As of January 2023, over 1000 large-scale hydrogen project proposals had been announced on a global scale.[39]

If existing commitments to reduce emissions are met by governments globally, it is projected that the demand for green hydrogen could increase from 89 million tonnes in 2020, to the required production of approximately 128 million tonnes of hydrogen equivalent by 2030, and 607 million tonnes of hydrogen equivalent by 2050.[40]

As countries strive to integrate green hydrogen into their energy ambitions, their approaches are likely to be tailored to local conditions, production capabilities, and sector-specific targets. For hydrogen to be considered "green hydrogen", it must be produced with renewable energy. Therefore, one key consideration is the varying availability of renewable energy resources across regions. For example, in several European countries, the demand for green hydrogen to achieve their net-zero commitments is substantial, but their limited access to renewable energy sources, and space limitations, mean they cannot meet this demand domestically.

Hydrogen production in major demand centres such as Japan, South Korea and Germany may only be able to cover demand by approximately 20%-30%. To effectively meet their green hydrogen demand and align with their climate change objectives, these demand centres will need to supplement their domestic production with imports.[45] Although Germany's expected hydrogen demand and production figures are only provided for 2030 in the table below, the country's hydrogen imports are expected to become their main source of supply, especially after 2040.[46] Analysis by KPMG indicates that in an ambitious scenario, the gap between supply and demand is expected to increase sixfold between 2030 and 2050. It is clear that Europe's hydrogen demand will not be able to be covered by intra-European green hydrogen production.[47]

Table 5: Expected green hydrogen supply versus demand for key demand centres

Key demand centre	2030/2050 total hydrogen demand	2030/2050 total hydrogen production	Gap/ imports (%)
Japan	20 million tonnes by 2050[41]	No notable domestic production[42]	Over 80%
South Korea	27.9 million tonnes per year by 2050[43]	5 million tonnes per year by 2050[43]	Over 80%
Germany	Approximately 2.8 million tonnes by 2030[44]	1 million tonnes annually by 2030[44]	Approximately 70%

Africa's potential to meet the growing green hydrogen demand

Africa's renewable energy potential positions the continent well to produce green hydrogen. Green hydrogen production relies on the availability of renewable energy to feed into the production cycle. In contrast to the demand centres, Africa possesses abundant renewable energy resources and vast amounts of non-arable land. Ethiopia and the Democratic Republic of Congo (DRC), for example, have the largest potential in hydropower as the Nile and Congo rivers (largest rivers on the continent) flow between their borders.[48] The Northern and Southern parts of the continent are particularly notable due to their high potential for renewable energy generation from wind (180,000 TWh per year) and solar (average daily potential of 4.49 kWh/kWp)[44], as well as their proximity to ports.[45,49]

Table 6: African countries making significant strides in the green hydrogen sector boast abundant wind and solar potential[50,51]

Country	Region	Potential Wind Power Generation (TWh/year)	Direct Normal Irradiance (kWh/m^2)
Algeria	North	24,980	6.97
Angola	South	1,379	7.10
Egypt	North	10,838	7.85
Ethiopia	East	3,208	6.59
Kenya	East	2,918	6.13
Mauritania	North	14,548	6.34
Morocco	North	2,074	7.20
Mozambique	South	1,570	5.51
Namibia	South	4,400	8.61
Nigeria	West	3,166	4.53
South Africa	South	6,970	8.50

Africa's rich renewable energy resources offer the potential to produce large quantities of green hydrogen and export this at a competitive price to regions that are not as equally endowed with renewable resources.

Alongside the abundant wind and solar power, low-cost hydro and geothermal power dominate the renewable sector. For instance, the geothermal potential held in countries of the East African Rift region presents a key consideration for green hydrogen production on the continent.[52]

According to reports by IRENA, there is a substantial difference in the average levelised cost of electricity for solar PV between the cheapest and most expensive regions, with a cost gap of USD 124 per MWh between the 5th and 95th percentiles. Onshore wind shows a smaller disparity of USD 42 per MWh for the same range. The World Economic Forum predicts that in the coming decade, the costs of solar PV, onshore wind energy, and offshore wind energy will decrease by 50%, 50%, and 30%, respectively, as the capital cost differences between regions narrow and domestic expertise develops.[53]

The above presents an opportunity for Africa to export hydrogen-based commodities (e.g. steel, ammonia, and synthetic fuels) in addition to pure hydrogen. It would be more economically viable and less carbon intensive for the demand centres in the Global North to import hydrogen-based commodities, than to convert the imported pure hydrogen themselves.

The energy input loss during the conversion of green hydrogen into other commodities, underscores the significance of utilising low-cost renewable electricity, which is more readily available in regions abundant with renewable resources, such as Africa. Moreover, the transportation costs of hydrogen-based commodities are relatively low in comparison to the transportation of green hydrogen in its pure form, which makes transportation from supply centres to demand centres easier.

At the beginning of 2023, the Hydrogen Council indicated that Africa had shown the highest increase (more than 200%) in announced supply in green hydrogen, with the Middle East following with an increased announced volume of 105%.[39] This is an indication of Africa's drive to invest in this technology. Moreover, the global demand for hydrogen is expected to be 607 million tonnes by 2050, while Africa's demand may reach 10 million to 18 million tonnes a year by 2050. It is estimated that Africa may have a surplus of between 20 million and 40 million tonnes of green hydrogen a year by 2050, after meeting their local demand. The surplus amount of green hydrogen presents the continent with an opportunity to export to the previously mentioned demand centres, whose localities do not allow for the large-scale production of green hydrogen.[38]

As several African nations are not bound by existing technology industries, unlike Europe and other industrialised nations, large-scale devaluations and exit risks are unlikely to be of significant concern. The combination of these factors, positions Africa's Northern and Southern regions as especially suitable for producing green hydrogen.

Notwithstanding the abundant renewable resource potential, strides towards green hydrogen production are not equal, as some countries within Africa are significantly more industrialised than others. As a result, the legacy assets may hinder the process due to considerations such as retrofitting, environmental impact, and infrastructural upkeep.

Harnessing green hydrogen to industrialise and develop Africa

The development of the green hydrogen sector has the potential to catalyse the process of industrialisation in Africa. The industrialisation journey of the Western world provides valuable insights into the path towards sustainable development. It underscores the critical importance of mitigating environmental impacts and prioritising the transition from fossil fuels to cleaner energy alternatives. Historically, an overdependence on non-renewable resources contributed to severe climate-related challenges. This historical context serves as a guide for regions such as Africa, enabling countries on the continent to make informed decisions about their industrialisation strategies. By adopting environmentally responsible technologies like green hydrogen, Africa can achieve its industrialisation goals while simultaneously reducing greenhouse gas emissions. This approach not only supports economic growth and development, but also aligns with a more sustainable and eco-conscious vision of the future, addressing the competing demands of industrialisation without further exacerbating environmental concerns.

The use of green hydrogen in Africa's industrialisation further presents an opportunity for the continent to confront various challenges such as unemployment, poverty, and low economic growth.

Several scenarios can lead to these outcomes, with three primary avenues standing out as promising approaches: 1) establishing green hydrogen as a new export commodity; 2) integrating it into domestic consumption; and 3) adopting a hybrid approach that combines both strategies for a comprehensive and sustainable impact. Each of these avenues holds the potential to drive socio-economic progress and contribute to Africa's development.

Through an export-orientated approach, investments are encouraged in both green hydrogen production processes and export infrastructure. This will not only generate export revenue but will also attract investments, stimulating economic growth and job creation. In the second avenue, green hydrogen can serve as the basis for creating industrial clusters and value chains to support local development and industrial diversification. It can be a catalyst for establishing new industries and creating new job opportunities within Africa. Considering the benefits of the export and domestic strategies, combining these into a hybrid approach can significantly boost and diversify revenue for the African continent. The generated revenue can be reinvested to strengthen the overall economy, support local communities, promote the transfer of skills, and enhance infrastructure development.

The cost of green hydrogen as a barrier to Africa's industrialisation

The outlined approaches offer sustainable solutions to tackle socio-economic challenges, foster industrial diversification, and advance Africa's economic growth while contributing to the global shift towards cleaner energy sources. However, the high cost of green hydrogen remains a notable hurdle in Africa's pursuit of this technology for industrialisation. Currently, the production costs associated with green hydrogen are considerably higher than that of grey hydrogen, which is derived from fossil fuels. Fossil fuel-based hydrogen costs from USD 0.5 to USD 1.7 per kg. while green hydrogen ranges from USD 3 to USD 8 per kg.[54] This is largely due to an immature market and technology.

The prevailing perspective suggests that at its current cost, green hydrogen may not be economically viable for domestic use in Africa. To ascertain the price point needed for Africa to integrate green hydrogen into local markets, KPMG conducted a price parity analysis. South Africa, being one of the continent's major contributors to greenhouse gas emissions, was taken as a case study in this research. The study aims to identify a competitive price level that enables the sustainable adoption of hydrogen, extending industrialisation beyond exports for industrial and economic growth in Africa.

Hydrogen parity pricing analysis

The aim of the analysis was to find the electricity parity price per kilogram for hydrogen (H_2) in South Africa.

Methodology

For a given power requirement we used the average cost per kWh for each category of Eskom's – South African state-owned electricity utility responsible for generating, transmitting, and distributing electricity in South Africa – business customer groupings to calculate the total electricity cost required by that business. E.g., if a particular industrial business requires 1 GWh of power, then, at an average derived cost of USD 0.06 per kWh, the cost of electricity for that business would be USD 60,000.

To calculate the break-even cost for hydrogen, one would need to deliver the same energy at a price less or equal to that total cost.

- Therefore, calculate the quantity of H_2 required to produce the same power i.e. 1 GWh. In this example it would require 30.03 kg of H_2 to produce 1 GWh of power, assuming an energy intensity factor of 1 kg of H_2 producing 33.3 kWh.
- Dividing the total cost of power required by the number of kilograms of H_2 results in a price of USD 1.86 per kg of H_2.
- Similar calculations can be done for the mining, agriculture and commercial categories using the average Eskom prices for each of these customer categories.

The results of this analysis are presented in the following table:

Table 7: Hydrogen parity price analysis

Category	Implied electricity cost per kWh[55]	Price H_2 (USD)[56]
Agriculture	2.16	3.78
Commercial	1.69	2.97
Mining	1.31	2.29
Industrial	1.06	1.86

- Different customer categories or sectors face different electricity prices, and therefore have different parity prices for the adoption of H_2. From the information above the agricultural sector would face the highest party price for H_2, while Industry would require the lowest H_2 price before adoption.

Assumptions underlying the analysis

- Municipal retail prices will be somewhat higher than Eskom wholesale prices, given the retail margin charged. This would increase the break-even price calculated above.
- Only operating costs are considered in the calculation above in order to compare like for like, since the electricity infrastructure is already a sunk cost for most end users. We assume that for any new location a choice would need to be made around whether hydrogen infrastructure, or the infrastructure for the alternative energy source (electricity, coal, diesel, etc.), would need to be installed, and that these costs would be similar once the technologies have been widely adopted.
- Storage, transport, and other costs are also not included and again would be a requirement for any chosen energy source.
- All businesses would therefore face costs that are unique to that business: the quantity of energy required, and the location of each business, for instance, will create some variation in the cost of H_2 when compared with the averages listed in the table above.

Due to variable costs related to infrastructure, transport and storage, the location of a business such as a mine or farm, may mean that the breakeven price of hydrogen is a magnitude higher than the averages published in Table 7, based on the additional costs required to supply that business with power of any variety. These variations in geography could have a significant impact on the final price of hydrogen that would represent a parity price to electricity. Moreover, green hydrogen's inherent volatility makes it more convenient to transport green hydrogen in alternative forms, such as ammonia. The reconversion of ammonia back to hydrogen, however, requires additional energy and results in energy losses of the commodity during the transformation, which may drive up input energy costs.[57]

However, the analysis suggests that achieving electricity price parity for hydrogen in South Africa can be realised sooner than commonly believed. This is significant, because the cost of producing green hydrogen in South Africa may become competitive with other forms of energy faster than expected and makes the technology more economically feasible to not only export, but for use in various applications. This would ultimately accelerate the adoption of green hydrogen as a clean and sustainable energy source in the region.

The drive from policymakers to accelerate the adoption of green hydrogen through initiatives such as greenhouse gas emission tariffs, and the steady expansion of electrolyser capacity, has set the expectation that green hydrogen production costs will decrease over the coming decades.[40,58]

The expected reduction in renewable energy costs will further propel the cost-effectiveness of the technology. Collectively, these factors have the potential to bring about cost parity between green and grey hydrogen as early as 2028.[40]

Status of green hydrogen development in front runner African countries

As the African continent seeks to take advantage of the green hydrogen opportunity, specific countries have been identified as potential key contributors to this cause. Egypt, Kenya, Mauritania, Morocco, Namibia, and South Africa possess abundant renewable energy potential and are positioned in favourable locations with vast non-arable land. These factors establish them as front-runners in the potential large-scale production of green hydrogen. To enable effective collaboration and fast-forward the development of green hydrogen projects in line with a Just Energy Transition, these countries, with the recent inclusion of Ethiopia and Angola[59], have established the Africa Green Hydrogen Alliance (AGHA).[40]

Through collaboration and coordinated action, the AGHA aims to accelerate the transition from fossil fuel overreliance through the development of green hydrogen projects in Africa.

The countries mentioned above exhibit slight variations in the opportunities and challenges they encounter as they seek to capitalise on the green hydrogen opportunity. Additionally, they host noteworthy green hydrogen projects that are in various stages of development. The tables on the next pages provide an overview of selected significant hydrogen opportunities, challenges, and flagship projects in Africa.

Table 8: Overview of key green hydrogen projects, opportunities, and challenges within the AGHA countries

Egypt	
Key Opportunities	• Large potential domestic demand for green hydrogen in energy-intensive industries that aim to decarbonise. • Geographical position is in close proximity to European demand centres, resulting in reduced transportation costs and great export opportunities. • Suitable infrastructure for the production and transportation of green hydrogen to Europe. • Government support of environmentally friendly initiatives through new environmental laws and incentives. • Part of the ISO technical committee (sets standards for the production, storage, transportation, measurement, and use of hydrogen) which could have a significant impact in aligning and facilitating the global trade of hydrogen and value-add products.
Key Challenges	• High up-front costs for green hydrogen development, implementation and research initiatives. • Key to producing green hydrogen is water, which the region faces a shortage of.
Flagship Projects	EBIC Ammonia
	Lead Developer: Fertiglobe Year: 2024 Electrolysis capacity: 100 MW
	EEHC – Siemens MoU
	Lead Developer: EEHC Siemens Year: TBA Electrolysis capacity: 100-200 MW
Government commitments	Egypt's low-carbon hydrogen strategy framework. A standard memorandum of understanding (MoU) has been prepared to serve as a nucleus for all green hydrogen production and trading projects, and the investments provided by the developers of these projects.

Kenya	
Key Opportunities	• Endowed with an abundance of renewable energy, specifically wind, hydro power, geothermal power, and solar energy. • One of the beneficiary countries receiving USD 23.97 billion from the European Union and European Investment Bank to support climate action in developing countries. • Recently launched its green hydrogen national strategy and roadmap at the Africa Climate Summit with the EU and Global Gateway Support for Clean Energy Transition. This was developed and supported by representatives from government, the private sector, development partners and academia.
Key Challenges	• Lack of legislation and regulation in the production, storage, and distribution of green hydrogen. • High cost of green hydrogen production. • Lack of enabling infrastructure for the production and distribution of green hydrogen.
Flagship Projects	Renewable Kenya (Kenya's first green hydrogen plant)
	Lead developer: HDF Energy Year: TBA Production: 180 MW of solar PV combined with 500 MWh of long-term hydrogen-based storage
	KenGen Green Hydrogen
	Lead developer: Kenya Electricity Generating Company (KenGen) Year: 2025 (Phase 1: Demonstration Plant) & 2028 (Phase 2: Electrolyser capacity plant) Electrolyser capacity: 100 MW
Government commitments	The Green Hydrogen Strategy and Road Map for Kenya.

Table 8: Overview of key green hydrogen projects, opportunities, and challenges within the AGHA countries (cont.)

Mauritania	
Key Opportunities	• Possesses wide-scale wind and solar potential. • Support from the African Development Bank and the World Bank which are supporting the nation in the development of their green hydrogen legal frameworks and knowledge transfer. • Geographical position is in close proximity to European demand centres resulting in reduced transportation costs and great export opportunities.
Key Challenges	• Lack of appropriate infrastructure such as roads connecting ports to the rest of the country and the shortage of pipelines for distribution. • Procurement of appropriate funding for green hydrogen projects and development. • Large scale hydrogen projects are still in planning stages with financial investment decisions not made.
Flagship Projects	Aman Green Hydrogen
	Lead Developer: CWP Global Year: 2030 Hydrogen production: 1.8 million tonnes per year
	Project Nour
	Lead Developer: Chariot Year: 2026 Electrolysis capacity: 10 GW
Government commitments	Strategic roadmap for the development of a low-carbon hydrogen industry in Mauritania.

Morocco	
Key Opportunities	• Geographical position is in close proximity to European demand centres resulting in reduced transportation costs and great export opportunities. • The region is part of the ISO technical committee (sets standards for the production, storage, transportation, measurement, and use of hydrogen) which could have a significant impact in aligning and facilitating the global trade of hydrogen and value-add products. • Has been ranked second in Africa on industrial performance by the African Development Bank.
Key Challenges	• Some technologies required in the hydrogen value chain are at a low level of maturity in comparison to the needs of large-scale testing. • Lack of legislation and regulation in the production, storage, and distribution of green hydrogen. • Lack of enabling infrastructure for the production and distribution of green hydrogen.
Flagship Projects	OCP Group Demonstration
	Lead Developer: OCP Group Year: 2022 Hydrogen production: 260 tonnes per year
	Masen Green Hydrogen
	Lead Developer: Masen Year: 2025 Electrolysis Capacity: 100 MW
	HEVO – Morocco
	Lead Developer: Fusion Fuel Year: 2026 Hydrogen production: 31,000 tonnes per year
Government commitments	Morocco Green Hydrogen Roadmap.

Table 8: Overview of key green hydrogen projects, opportunities, and challenges within the AGHA countries (cont.)

Namibia	
Key Opportunities	• Has one of the best solar renewable energy sources on the continent. • The Namibian Government has established the Namibian Government Southern Corridor Development which aims to develop industrial-scale export-oriented capacities.
Key Challenges	• Key to producing green hydrogen is water which is scarce in the region. • Distance to demand centres places a challenge on the country's competitive advantage.
Flagship Projects	O&L Group - CMB.TECH hydrogen hub
	Lead Developer: O&L group CMB.TECH Year: 2023 Electrolysis Capacity: 4 MW
	Renewstable Swakopmund
	Lead Developer: HDF Energy Namibia Year: 2025 Electrolysis Capacity: 24 MW
	Hyphen Hydrogen Energy - Phase I
	Lead Developer: Hyphen Hydrogen Energy Year: 2026 Hydrogen production: 120,000 tonnes per year
	Hyphen Hydrogen Energy - Phase II
	Lead Developer: Hyphen Hydrogen Energy Year: TBA Electrolysis Capacity: 3 GW
Government commitments	Namibia Green Hydrogen and Derivatives Strategy.

South Africa	
Key Opportunities	• Has one of the best solar renewable energy conditions on the continent. • Endowed with platinum group metals (PGMs) which accounts for more than 80% of the world's reserves. This is of particular significance due to the essential role of PGMs in fuel-cell technology. • Region possesses a strong green hydrogen research and development base. • Government support through the adoption of the Hydrogen Society Roadmap. • Country has the most sophisticated capital markets and financial system on the continent.
Key Challenges	• Distance to demand centres places a challenge on the country's competitive advantage. • Inconsistent energy supply creates significant competing demands as the country is keenly focused on establishing energy security, which may take priority. • The region has significant fiscal constraints due to a high debt to GDP ratio which limits government's capacity to invest in new infrastructure. • Transmission capacity resides in areas that have coal mines (which is where the thermal power stations are). This is not effective when assessing renewable energy as the required energy sources are in different areas. This could result in considering if the investment should go into enhancing transmission grids or other mechanisms that could capture green hydrogen. • Gas and electricity infrastructure in this region would need significant development to produce and deliver green hydrogen in a manner that is cost-effective.

Table 8: Overview of key green hydrogen projects, opportunities, and challenges within the AGHA countries (cont.)

South Africa (cont.)	
Flagship Projects	Anglo-American Mogalakwena mine
	Lead Developer: Anglo-American Year: 2022 Electrolysis capacity: 3,500 tonnes per year
	Sasolburg green hydrogen
	Lead Developer: Sasol Year: 2023 Hydrogen production: 2,000 tonnes per year
	Coega Nelson Mandela Bay green ammonia
	Lead Developer: Hive Energy Year: 2026 Hydrogen production: 140,000 tonnes per year
	Secunda SAF – Phase I
	Lead Developer: Sasol Year: TBA Hydrogen production: 8,000 tonnes per year
	Secunda SAF – Phase II
	Lead Developer: Sasol Year: 2040 Hydrogen production: 1,300 tonnes per year
	Boegoebaai green hydrogen
	Lead Developer: Sasol Year: TBA Hydrogen production: 400,000 tonnes per year
Government commitments	• The Hydrogen Society Roadmap South Africa. • The Green Hydrogen Commercialisation Strategy for South Africa.

Recent significant investment announcements

Over the last 5 years, significant financial announcements, and investments towards the development of a green hydrogen economy have been made in Africa. North African countries such as Mauritania and Egypt, for instance, have investment announcements and projects across the value chain investing in areas such as electrolysis installation and supply chain establishment.

This year Southern Africa has seen the establishment of the first blended financing fund for green hydrogen projects, with a second fund pending establishment. These funds present an investment opportunity for public and private investors looking to align their portfolios with the transition to a low carbon economy and capitalise on a first-mover advantage. Although green hydrogen is gaining momentum in Africa, many of the projects envisioned are still in their early stages and will still need to go through several processes to reach financial close.

The illustration on the following page indicates the most notable green hydrogen investment announcements over the past 5 years in Africa.

Project Nour: Chariot Energy Group and Total Eren's green hydrogen project in Mauritania

Investment amount
- USD 3.5 billion

Actors
- Chariot Energy Group in partnership with Total Eren
- Government of Mauritania

Aim
To support Mauritania in becoming a leading producer and exporter of green hydrogen.

BP and the Government of Mauritania signed an MoU to explore the scaling up green hydrogen production (2022).

Actors
- Mauritania
- BP

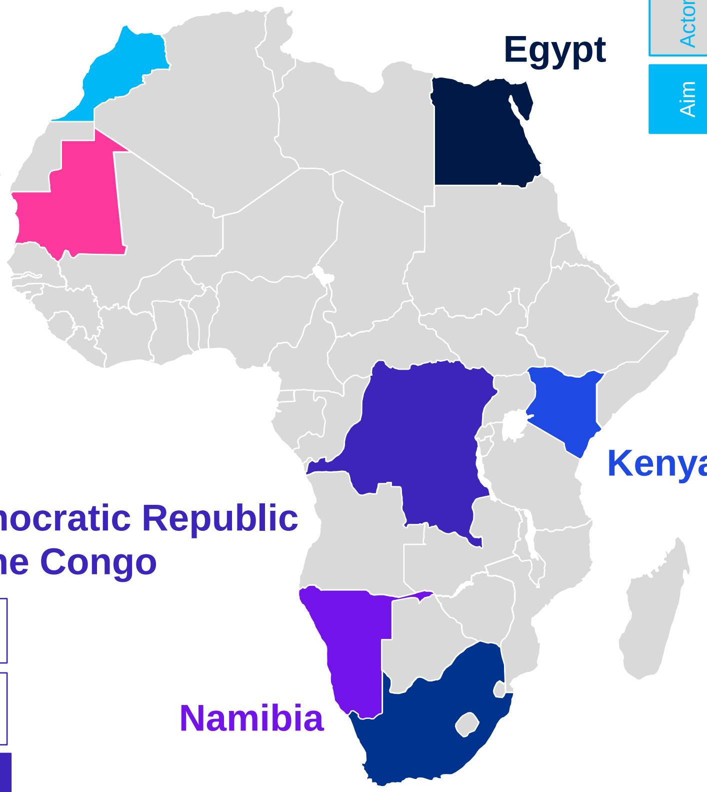
Aim
Aims to build on BP's presence in a country where it is already developing a large liquefied natural gas (LNG) facility, and to explore ways to develop low-carbon hydrogen on a large scale.

The Grand Inga Hydropower Project

Investment amount
- USD 50 billion – USD 80 billion

Actors
- Fortescue Metals Group
- Democratic Republic of the Congo

Aim
The project is proposed to create a major downstream green hydrogen and green ammonia industry. It is designed to contribute to the electricity supply for the Democratic Republic of Congo and the entire continent. It is intended to have a total installed capacity of over 42 GW.



Total Eren to Launch Green Hydrogen Megaproject in Morocco (2022)

Investment amount
- USD 10.6 billion

Actors
- Total Eren
- Morocco

Aim
The project is aimed at launching a green hydrogen and ammonia production plant.

The Egyptian Electricity Holding Company and Siemens Energy signed a Memorandum of Understanding on the development of the green hydrogen industry (2021)

Actors
- Egyptian Electricity Holding Company
- Siemens Energy Egypt

Aim
Collaborate on the development of the green hydrogen industry in Egypt by exploring the possibilities of green hydrogen generation from renewable electricity.

Signing of a Joint Declaration on Renewable Clean Hydrogen between European Investment Bank (EIB) and Kenya (2023)

Investment amount
- Initially USD 1.97 million of grants from the European Union.
- Appraise possible loan financing for larger green hydrogen-related investments.

Actors
- European Investment Bank (EIB)
- Republic of Kenya

Aim
Collaboratory identification and development of new renewable energy projects, unlocking investments and the construction of hydrogen production infrastructure.

The establishment of the SDG Namibia One (2023)

Investment amount
- USD 1.09 billion
- A portion of the USD 547.35 million committed by the European Investment Bank and the Government at COP27 intended for investment through SDG Namibia One.

Actors
- Namibia's Environment Investment Fund
- Dutch organizations: Climate Fund Managers and Invest International

Aim
Attract funds from local and global investors for the advancement of green hydrogen projects and associated infrastructure in Namibia.

The intention to launch the SA-H_2 Fund' (SA-H2). (2023; pending establishment)

Investment amount
- USD 1 billion

Actors
- Climate Fund Managers (CFM) and Invest International B.V. (II) from the Netherlands
- Sanlam Limited in South Africa (Sanlam)
- The Development Bank of Southern Africa (DBSA),
- The Industrial Development Corporation of South Africa (IDC), in partnership with other strategic collaborators

Aim
Partnership of private and public enterprises, and international and domestic institutions collaborating to expedite the growth of South Africa's green hydrogen sector and circular economy.

South Africa secures USD 7.16 billion at COP26 for a 'just energy transition' (2021)

Investment amount
- USD 7.16 billion

Actors
- South Africa
- America
- Britain
- France
- Germany
- The European Union

Aim
South Africa secured USD 7.16 billion over the next three to five years to help end the reliance on coal. The investment is in the form of grants, concessional loans and investment and risk-sharing instruments – including mobilising private sector funding.

Key considerations for green hydrogen investments in Africa

The green hydrogen potential across Africa's 54 nations displays significant variations. These disparities may influence investors in their decision-making process regarding where to allocate their investments within this sector. There are several factors to consider when assessing hydrogen investment decisions in Africa which include the specific country's current energy mix, renewable energy resources, availability of relevant inputs, research and development capability, availability of key skills, infrastructure, social and political climate, and production capacity.[60]

Significant investment is required within the context of competing energy demands, as export orientated markets will have to compete with local energy provision. Consideration must also be given to the impact of the energy transition on society and how investors and government must work together to support a just energy transition. Governments within Africa have various policies and laws that require investments to advance local skills and/or employment. These should be well understood and adhered to in each region. There is, however, additional work to be done to establish official legislation and policy frameworks with regards to the green hydrogen value chain.

It is critical to consider that some of the investment considerations listed above may be prioritised differently by investors who have varying investment goals, strategies, and particular projects of interest. The changing global trends in green hydrogen may also impact the considerations one should make before investing in this sector in Africa.

Risk Assessment and Mitigation in Africa's Renewable Energy Projects

The quest for green energy solutions should direct global attention towards the African continent, a region brimming with untapped renewable potential. However, a deeper exploration reveals that potential investors often find themselves navigating a labyrinth of risks. Most of the typical risks in Africa can be mitigated, provided the developers (and investors) are aware of them.

Political Stability

The African continent's political history is a tapestry of colonial legacies, post-independence struggles, and nation-building. Post the decolonisation era of the 1950s and 1960s, many African nations faced challenges establishing stable governance structures. Coups, civil wars, and ethnic tensions became defining features of the political landscape in various regions. Countries like Nigeria, Angola, and Sierra Leone saw protracted civil wars fuelled in part by resource control, significantly deterring foreign investment. This tumultuous historical backdrop has cast a long shadow, with investors often viewing the continent through a lens tinted by its past.

Fast forward to the present, and while many African countries have made significant strides towards democratic stability, the vestiges of the past still influence perceptions. Recent political upheavals in countries like Libya, Sudan, and Zimbabwe underscore the persisting vulnerabilities.

For instance, in the past decade, countries like Libya and South Sudan have experienced political upheavals, leading to significant investor trepidation. Such scenarios raise fears of expropriation, where governments might take over foreign-owned assets without adequate compensation. In 2019, Tanzania passed laws that posed challenges for foreign investors, allowing the government to renegotiate or dissolve contracts. These instances fuel an existing lingering fear among investors about the nationalisation of assets created by historical instances, such as Zambia's nationalisation of the copper mines in the 1970s. For renewable projects, this might mean a takeover of solar farms or wind installations without adequate compensation. And even if it doesn't come as far as expropriations, contractual disputes with new policy makers can lead to economically similar results, as governments might renegotiate or dissolve power purchase agreements, affecting any project's financial viability. Tariffs set for energy might be revised, impacting the revenue models for investors.

Last but not least, foreign relations are affected by local or regional instability: The relations between an African nation and an investor's home country play an essential role in the project's success. Diplomatic tensions can result in reduced support or even withdrawal of investments.

Political stability is undeniably a critical factor influencing foreign investments in Africa's renewable sector. While historical and contemporary events have fuelled these concerns, it's essential to adopt a nuanced view. Firstly, it is important to realise that Africa is not one place: there are 54 different countries in Africa, all with different political stabilities and regulatory certainties. It makes little sense not to invest in a solar project in Botswana, because there have been reports about instability concerns in the horn of Africa. Similarly, one needs to be careful not to think that because Kenia is a good investment destination in Africa, that its neighbour Tanzania is the same.

> **Investors should make sure they understand the real political and policy environment in a country and not think about all African countries the same.**

With thorough research, risk assessment, local advisors and partners, and by leveraging instruments like political risk insurance, investors can navigate the complex political terrains of Africa, tapping into its vast renewable potential. If the political risks in a country is still too high for their liking, investors can consider various different types of insurance facilities. MIGA, for instance, has supported projects worth over USD 3.5 billion in Sub-Saharan Africa as of 2020, offering protection against unforeseen political adversities.

Regulatory Certainty

Regulatory landscapes can sometimes be akin to shifting sands. A case in point is South Africa, where the Renewable Energy Independent Power Producer Procurement (REIPPP) program experienced delays in 2015 due to concerns about electricity pricing, causing investor apprehension. Consistent engagement with policy makers and investment in capacity-building can create a more predictable environment. This context is however slowly changing as more and more African governments realise the importance of foreign investments in their countries to drive economic growth that can lead to job creation and poverty reduction. Similar to political stability, regulatory certainty is not the same for all countries. Investors should understand which countries have stable governments and look at the trajectory of policies and regulations in countries. If the trajectory has been consistent and continuously improving and the political situation is stable, then the country has a significantly reduced risk from a regulatory certainty perspective.

Regulatory certainty should be one of the key considerations for investors as it could affect numerous different components required to make a financially viable project:

- **Licensing and Permits**: The establishment and operation of renewable energy projects require various licenses and permits. Frequent changes in the processes or criteria for these licenses, perhaps due to policy shifts or bureaucratic restructuring, can delay or derail projects. For instance, a solar farm might face hurdles if land-use regulations are suddenly altered.
- **Tariff Structures**: One of the most significant concerns for renewable energy investors, is the tariff structure. Power Purchase Agreements (PPAs) lock in tariffs for energy sold to the grid. Any unpredictability in how tariffs are set, or revised, can significantly affect the financial viability of a project. Countries that frequently alter their tariff determination methodologies should be approached more cautiously.
- **Environmental and Safety Standards**: Renewable projects have specific environmental and safety implications. Regulatory clarity on standards and compliance requirements is essential. Ambiguities or frequent changes in these standards can lead to unforeseen costs and project delays.
- **Taxation and Incentives**: Many countries offer tax incentives to promote renewable energy investments. However, if the regulatory environment is unstable, these incentives might be withdrawn or reduced. Such concerns can affect long-term investment decisions.
- **Foreign Ownership and Capital Controls**: Regulations related to foreign ownership of assets and repatriation of profits are critical for overseas investors. Countries that have histories of sudden capital controls or restrictions on foreign ownership can be viewed as high-risk investment destinations.

While regulatory challenges are genuine, it's crucial to understand the diverse nature of the African continent. Not all countries have unstable regulatory environments. For instance, nations like Morocco have been lauded for their consistent policies promoting renewable energy, leading to successful projects like the Noor Ouarzazate Solar Complex. Moreover, regional bodies like the African Union and collaborations like the Power Africa Initiative have been working diligently to create harmonised regulatory guidelines and promote best practices across the continent.

Environmental Implications

The ecological impact of renewable projects can be significant. For example, the Lake Turkana Wind Power project in Kenya, the largest of its kind in Africa, faced concerns about potential harm to local bird populations. Addressing such challenges requires comprehensive environmental impact assessments. Beyond assessments, environmental liability insurance, like those offered by African Trade Insurance Agency (ATI), can cover unforeseen damages, ensuring projects remain both ecologically and economically viable. When investors consider which projects to invest in, it is not only critical to make sure that all the necessary environmental compliance steps and studies have been done, and the required mitigation plans have been developed, but also to understand the content of the environmental reports. A wind farm on the West Coast of South Africa has, for instance, easier-to-overcome environmental concerns than one in the Drakensberg mountains in the same country where the critically endangered Bearded Vulture (*Gypaetus barbatus*) breeds. It is important to note, that even though all the right environmental processes have been followed, some projects can still be stopped (or significantly delayed) by environmental rights groups, because of critical biodiversity concerns. It is therefore advisable to understand whether the environmental findings in the impact assessments will be manageable or whether they are of such a nature that it will be more advisable to look for projects with a lower environmental impact, and the associated likelihood of delays or cancellation.

Social License to Operate

Community engagement is not just ethical but also strategic. In Ghana, a solar project faced delays when local communities raised concerns about land rights. Such instances underline the importance of early community consultations. Tailored community-based insurance solutions, which compensate locals for disruptions, can be a step towards fostering trust. For instance, initiatives in Senegal offer community insurance, safeguarding local interests against potential project adversities. Community engagement is one of the areas where most developers get it wrong. If the communities have not been properly incorporated in the planning phases of the project, and if there is no direct benefit to them, there is a risk that the communities will not only stop the project, but there could be health and safety risks for employees and risk of damage to infrastructure. The good news is that there are many examples across the continent that can be used to show exactly what to do, and how to do it, to derisk projects from a social licence to operate perspective. The bad news is that many developers take short cuts here: either because they think they know better, or because they try and do things in the way it will be done in the developed world, instead of being cognisant of the unique nuances to each different community in Africa. Investors should make sure that the developers followed best-practice processes for engaging with the communities, and that the project has been set up in a way that will unlock direct benefit to the community. If developers can't explain the processes they followed in a logical manner, explain why the processes were followed, how the processes tie into the national legislation, local customary law and best practice for that area, and how all of this were communicated to the different stakeholders, then there could be social risks that will boil over in time.

Network Infrastructure

A two-pronged approach focusing on energy generation and distribution infrastructure is essential. Collaborative financing models, like the one between the African Development Bank and the African Union, which pledged USD 12 billion for energy projects in 2020, can however bridge infrastructural gaps. Infrastructure insurance solutions can further insulate projects from damages and disruptions. In many African countries the grid is not yet upgraded (coverage, efficiency, technology) sufficiently to enable renewable projects to wheel their generated energy to the off-takers. If the off-taker for a project requires the project to tie into the grid, investors should make sure that the grid infrastructure in the project location is capable of supporting the project.

In summation, while the African renewable sector presents undeniable risks, they are far from insurmountable. By understanding the nuances of these challenges, backed by local knowledge and experience, and by employing strategic mitigation measures, Africa can transition from being a land of potential to a powerhouse of renewable energy.

Considerations for Successful Renewable Energy Projects in Africa

Successful renewable energy projects on the continent will need a number of things to be in place.

a) **Political goodwill and government support**: Political goodwill and government support is critical for the successful development of most renewable energy projects. Project developers and sponsors will therefore have to engage effectively with government bodies such as the legislative bodies, energy regulators, power distributers and transmitters, and PPP units. This will ensure that the regulatory support is in place for project sponsors to secure a Power Purchase Agreement (PPA) with the government.

b) **Relationship management**: Renewable energy projects require multiple partners covering technical expertise, project management, construction and equipment services and financing. The time from inception to completion, as well as the complexity and number of partners, highlight the importance of building and maintaining trust for a consortium leading the development of these projects.

c) **Financing**: Capital requirements for most renewable energy projects are large. Therefore, a financial package consisting of private equity, commercial bank debt, development finance, and climate finance is recommended to support the development of these projects. Climate finance is an innovative solution, especially for African countries grappling with limited fiscal space. The uptake of debt-for-climate swaps across Africa, however, remains low. These instruments would allow African countries that borrowed money from other nations or multilateral institutions, to have their debt forgiven if the money that was to be spent on repayment, is diverted to climate adaptation projects. In addition, there are multiple multilateral climate funds that renewable energy projects can tap into, such as the Green Climate Fund, the Global Environment Facility Fund, and the Adaptation Fund.

d) **Partial risk guarantees**: For on-grid projects, lenders and investors in renewable energy projects require risk mitigation instruments that provide cover against possible failure by government to meet its contractual obligations to a project.

e) **Land**: Renewable energy projects require relatively large areas of land (especially wind) to be set aside for accommodating the infrastructure. Making sure that the legal and customary law land rights have been secured, will be critical to success.

f) **Stakeholder engagement**: Renewable energy projects must involve the communities affected by the project. Therefore, co-creating the solutions with communities is critical to reduce the risk of backlash from local communities that could lead to project delays.

g) **Electricity exports** from countries with significant wind and solar energy resources but smaller energy markets, supported by cross-border transmission infrastructure, will be required for certain projects.

h) **Localisation** across the renewable energy value chains, especially in respect to manufacturing, will result in both forex savings for African countries through import substitution of capital goods in the long run, and drive a more just transition through increased job creation and socio-economic stimulation.

i) **Local African advisors and partners** can play a critical role in derisking projects. Every country, location in that country, and host community is different. Local knowledge and experience in the area can therefore play a key role in mitigating location-specific risks.

Conclusions

Social Licence to Operate is a key consideration for all renewable energy projects. Every community is different in their demographics, socio-economic standing, education levels, customary law and stability. A one-size-fits-all community engagement approach will therefore likely fail. If project developers can't explain every step of their stakeholder engagement process and why that step has been done in the context of the local communities' reality, then there will likely be risks that aren't planned for.

Africa has significant solar assets across the continent. Large parts of Africa have a significantly higher bankable Global Horizontal Irradiation (GHI) range, than countries in the Global North. Given that there is a large overlap between non-arable land and where the GHI is the highest, the technical and technological risks for projects in these regions, will be low.

If Africa were to exploit all of its wind resources for renewable energy generation, it could easily bridge the current energy provision gap on the continent. Given the amount of land required for large scale wind energy generation, there could however be significant environmental and social risks that need to be managed on these projects. This does not mean investors should shy away from wind projects – just be aware of the risks and make sure that they have been adequately mitigated.

To unlock the significant capital requirement for large-scale renewable energy projects, and to diversify the financial risks, projects reaching financial close will likely have a financial package consisting of private equity, commercial bank debt, development finance, and climate finance.

Africa is a great opportunity for capital providers to invest in renewable energy projects that will be critical for the global drive to decarbonise. **Africa can be the heart of the global decarbonisation solution: provided clean energy investments increase on the continent.**

Even though investment in renewable energy projects on the continent is picking up speed, the acceleration is too slow to provide energy to the 600 million Africans that still doesn't have access to energy, and to help the world's decarbonisation efforts.

Just because an Environmental Impact Report has been done, does not mean the identified risks have been adequately addressed. Some environmental impacts might be significantly higher than others, or unlock increased emotions from environmental non-profits and community at large. If these are not adequately managed, there could be delays in the project, or even termination.

Green hydrogen and hydrogen-based commodities could play a central role in aligning Africa's decarbonisation drive with its need to industrialise. If the current cost considerations can be adequately addressed, Africa can leverage its significant clean energy assets to support a large green hydrogen economy on the continent that can simultaneously drive job creation, industrial diversification, and decarbonisation.

For societal upliftment and long-term sustainability, it will be critical that all renewable energy projects on the continent play a fundamental role in ensuring that the transition from fossil fuel energy to renewable energy, is just. This means that projects should ensure that their host communities benefit directly from the project; that the project does not destroy future value; that the supply chain is localised as far as possible; and that the mechanisms put in place to support and uplift of the community are sustainable in the long run.

Capital investors from the Global North should not think about Africa as one place. Africa has 54 different countries, each with its own opportunities and risks. Many countries in Africa have stable political environments and regulatory certainty, so it does not make sense to price in the same risk for these countries than it does for those where the political and regulatory risks are high.

Citations

1. Addy, Richard (2022), 'The Business in Africa Narrative Report'. Available at: The Business in Africa Narrative Report (au.int)
2. United Nations Conference on Trade and Development (2023), 'Investment flows to Africa dropped to $45 billion in 2022', 05 July 2023. Available at: https://unctad.org/news/investment-flows-africa-dropped-45-billion-2022
3. World Meteorological Organisation (2022), 'State of Climate in Africa highlights water stress and Hazards', 08 September 2022. Available at https://wmo.int/news/media-centre/state-of-climate-africa-highlights-water-stress-and-hazards
4. Global Centre on Adaptation (2022), 'New report reveals Africa is facing a crisis in funding for climate adaption', 03 November 2022. Available at New report reveals Africa is facing a crisis in funding for climate adaptation - Global Center on Adaptation (gca.org)
5. Cozzi. Laura, Chen, Olivia, Hyeju, Kim (2023), 'The world's top 1% of emitters produce over 1000 times more CO2 that the botton 1%', IEA, 22 February 2023. Available at The world's top 1% of emitters produce over 1000 times more CO2 than the bottom 1% – Analysis - IEA
6. African Development Banking Group (2023), 'Africa DNC Hub'. Available at Africa NDC Hub | African Development Bank Group - Making a Difference (afdb.org)
7. The Climate Policy Initiative (2022), 'Landscape of Climate Finance in Africa'. Available at *Landscape-of-Climate-Finance-in-Africa.pdf (climatepolicyinitiative.org)
8. Mandela, Nelson (2005), 'Address by Nelson Mandela for the "Make Poverty History" Campaign London – United Kington', 03 February 2005. Available at http://www.mandela.gov.za/mandela_speeches/2005/050203_poverty.htm
9. The World Bank (2023), 'Sub-saharan Africa – data'. Available at: Sub-Saharan Africa | Data (worldbank.org). (Accesses 08.10.2023)
10. Naidoo, Prinesha (2023), 'Blackouts May Cost South Africa $51 Million a Day, Central Bank Say', Bloomberg. Available at https://www.bnnbloomberg.ca/blackouts-may-cost-south-africa-51-million-a-day-central-bank-says-1.1879989
11. International Energy Agency (2023), 'World Energy Outlook 2023'. Available at https://www.iea.org/reports/world-energy-outlook-2023
12. IRENA (2021), 'The Renewable Energy Transition in Africa'. Available at IRENA | The Renewable Energy Transition in Africa
13. Solar Irradiance Data. Available at https://solargis.com/
14. Global Wind Atlas. Available at https://globalwindatlas.info/en
15. IRENA (2022), 'Renewable Energy Market Analysis'. Available at https://www.irena.org/publications/2022/Jan/Renewable-Energy-Market-Analysis-Africa
16. RES4Africa Foundation, Africa's Energy Future is Renewable Report, June 2023. Available at https://res4africa.org/wp-content/uploads/2023/06/Africas-Energy-Future-is-Renewables-Flagship2023.pdf
17. International Energy Agency (2023), 'Financing Clean Energy in Africa'. Available at https://www.iea.org/reports/financing-clean-energy-in-africa
18. Africa Investment Forum showcases $1.475 billion in green and renewable energy deals at African Development Bank, (2023), Annual Meetings. Available at https://www.afdb.org/en/news-and-events/press-releases/africa-investment-forum-showcases-1475-billion-green-and-renewable-energy-deals-african-development-bank-2023-annual-meetings-61353
19. IRENA (2021), 'Renewable Energy Finance Flows'. Available at https://www.irena.org/Data/View-data-by-topic/Finance-and-Investment/Renewable-Energy-Finance-Flows
20. PitchBook (2023), 'PitchBook Data'. Available at https://pitchbook.com/
21. IRENA (2023), 'Renewable Energy and Jobs: Annual Review 2023'. Available at https://www.irena.org/Publications/2023/Sep/Renewable-energy-and-jobs-Annual-review-2023
22. International Solar Alliance (2022), World Solar Investment Report. Available at https://isolaralliance.org/uploads/docs/a15941394105403ec59b9b1e569c7d.pdf
23. DUKES (2023), Chapter 5: Electricity. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1174357/DUKES_2023_Chapter_5.pdf
24. The Economic Times, Energyworld.com, Renewables, hydro cross 40 per cent of India's installed power generation capacity in FY23: Report. Available at https://energy.economictimes.indiatimes.com/news/renewable/renewables-hydro-cross-40-per-cent-of-indias-installed-power-generation-capacity-in-fy23-report/100151725
25. Statista, Cumulative installed power capacity in Spain in 2022, by technology. Available at https://www.statista.com/statistics/1002759/installed-power-capacity-in-spain/#:~:text=In%202022%2C%20the%20total%20installed,combined%20cycle%20and%20solar%20photovoltaic.
26. Balkan Green Energy News, Turkey becomes 6th country in Europe to reach 100 GW in electricity capacity, 12 April 2022. Available at https://balkangreenenergynews.com/turkey-becomes-6th-country-in-europe-to-reach-100-gw-in-electricity-capacity/
27. Statista, Installed electricity generation capacity in Brazil from 2013 to 2022. Available at https://www.statista.com/statistics/985486/brazil-electricity-generation-installed-capacity/#:~:text=The%20installed%20capacity%20for%20electricity,percent%20from%20the%20previous%20year
28. Energypedia (2023), Mozambique Electricity Situation. Available at https://energypedia.info/wiki/Mozambique_Electricity_Situation#:~:text=data%20from%20EDM-,Installed%20capacity%20(Renewable%20sources),EDM%20and%2018%25%20to%20IPP
29. International Trade Administration, Kenya - Country Commercial Guide, 19 August 2022. Available at https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems
30. Energypedia (2023), Nigeria Electricity Situation. Available at https://energypedia.info/wiki/Nigeria_Electricity_Sector#:~:text=Main%20sources,-Figure%209%3A%20Power&text=Nigeria%20has%20a%20total%20installed,11%2C972MW%20(Figure%209)
31. International Trade Centre (2023), Trade Statistics, Import of Goods. Available at https://intracen.org/resources/data-and-analysis/trade-statistics

< ⌂ >

Citations (cont.)

32. IRENA (2022), 'Renewable Energy Finance Flows'. Available at https://www.irena.org/Data/View-data-by-topic/Finance-and-Investment/Renewable-Energy-Finance-Flows

33. African EU Energy partnership, Wind Energy: Joining Forces for an African Lift-Off, February 2022. Available at https://africa-eu-energy-partnership.org/wp-content/uploads/2022/02/AEEP_Wind_Energy_Policy_Brief_2022-3.pdf

34. Global Wind Energy Council, Africa Windpower. Available at https://gwec.net/global-wind-energy-council/taskforces-committees/africa-windpower/

35. International Finance Corporation (IFC) study. Available at africa-wind-technical-potential-oct-2020-ifc.pdf

36. African Business, African wind power struggles to gain momentum, 14 June 2022. Available at https://african.business/2022/06/energy-resources/african-wind-power-struggles-to-gain-momentum

37. IRENA (2022), 'Green Hydrogen for Industry: A guide to policy making'. Available at Green hydrogen for industry: A guide to policy making (irena.org)

38. Burger, S. (2023), 'Africa can and should harness its hydrogen potential for development'. Creamer Media's engineering News. Available at Africa can and should harness its hydrogen potential for development (engineeringnews.co.za)

39. Hydrogen Council, McKinsey & Company (2023), 'Hydrogen Insights 2023: An update on the state of the global hydrogen economy, with a deep dive into North America'. Available at Hydrogen Insights 2023 | Hydrogen Council\

40. Green Hydrogen Organisation (2022), 'Africa's Green Hydrogen Potential (AGHA)'. Available at Africa's Green Hydrogen Potential.pdf (gh2.org)

41. Agency for Natural Resources and Energy (2023), 'Overview of Basic Hydrogen Strategy'. Available at The Agency for Natural Resources and Energy presented outline of hydrogen basic strategy and highlighted standard for "low carbon hydrogen" - ECCJ / Asia Energy Efficiency and Conservation Collaboration Center

42. Calabrese, J. (2023), 'Japan looks to the Gulf as it bets big on hydrogen'. Available at Japan looks to the Gulf as it bets big on hydrogen | Middle East Institute (mei.edu)

43. S&P Global Commodity Insights (2021), 'S Korea to provide 27.9 mil mt/ year of 'clean hydrogen' by 2050'. Available at S Korea to provide 27.9 mil mt/year of 'clean hydrogen' by 2050 | S&P Global Commodity Insights (spglobal.com)

44. Collins, L. (2023), 'Germany doubles its green hydrogen production target for 2030 in new update of national strategy.' Available at https://www.hydrogeninsight.com/policy/germany-doubles-its-green-hydrogen-production-target-for-2030-in-new-update-of-national-strategy/2-1-1491715

45. Yohannes, B, and Diedou, A. (2022), 'Green hydrogen: A viable option for transforming Africa's energy sector'. United Nations Africa Renewal. Available at Green hydrogen: A viable option for transforming Africa's energy sector | Africa Renewal (un.org)

46. Wettengel (2021), 'Germany's future hydrogen needs significantly higher than expected – report'. Clean Energy Wire: Journalism for the energy transition. Available at Germany's future hydrogen needs significantly higher than expected – report | Clean Energy Wire

47. Hydrogen Central. (2021), 'European Hydrogen Backbone grows to 40,000 km, covering 11 new countries. Available at European Hydrogen Backbone grows to 40,000 km, covering 11 new countries - Hydrogen Central (hydrogen-central.com)

48. Chigbu, U. E., & Nweke-Eze, C. (2023), Green Hydrogen Production and Its Land Tenure Consequences in Africa: An Interpretive Review. Land, 12(9), 1709. Available at https://doi.org/10.3390/land12091709

49. Nour AbouSeada and Tarek M. Hatem (2022), Climate action: Prospects of green hydrogen in Africa. Available at https://www.sciencedirect.com/science/article/pii/S2352484722004759

50. Wind Energy Council (2020), 'Exploring Africa's Untapped Wind Potential'. Available at Exploring Africa's Untapped Wind Potential - Global Wind Energy Council (gwec.net)

51. IRENA (2023), 'Renewable Capacity Statistics 2023'. Available at Renewable capacity statistics 2023 (irena.org)

52. IRENA (2020), 'Geothermal development in Eastern Africa'. Available at Geothermal development in Eastern Africa (irena.org)

53. World Economic Forum (2020), 'Energy Technologies 2030: Wind and solar PV will keep taking the lead', Community Report. Available at WEF_Wind_and_Solar_2030.pdf (weforum.org)

54. Koons, E. (2023), 'Hydrogen Cost: Can We Afford It?'. Available at Hydrogen Cost: Can We Afford It? (energytracker.asia)

55. Eskom (2022), 'Eskom Integrated Report 2022'. Available at 2022_integrated_report.pdf (eskom.co.za)

56. Assuming an exchange rate of R19 per USD.

57. International Energy Agency (IEA) (2023), 'Global Hydrogen Review 2023'. Available at https://iea.blob.core.windows.net/assets/cb9d5903-0df2-4c6c-afa1-4012f9ed45d2/GlobalHydrogenReview2023.pdf

58. The Department of Trade Industry and Competition (2022), 'Green Hydrogen Commercialisation Strategy for South Africa: Final Report'. Available at Full-Report-Green-Hydrogen-Commercialisation-Strategy.pdf (thedtic.gov.za)

59. The Presidency Republic of South Africa (2023), 'South Africa assumes chairship of Africa Green Hydrogen Alliance at Africa Climate Summit in Nairobi'. Available at South Africa assumes chairship of Africa Green Hydrogen Alliance at Africa Climate Summit in Nairobi | The Presidency

60. Neuma Grobbelaar and Lwazi Ngubevana (2022), ‚Ensuring a Just Energy Transition through Hydrogen: How the G20 can Support Africa'. Available at https://saiia.org.za/research/ensuring-a-just-energy-transition-through-hydrogen-how-the-g20-can-support-africa/

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A special thank you to our other colleagues that also contributed to the development of the report

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